PLASTICS

DECEMBER 1960

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

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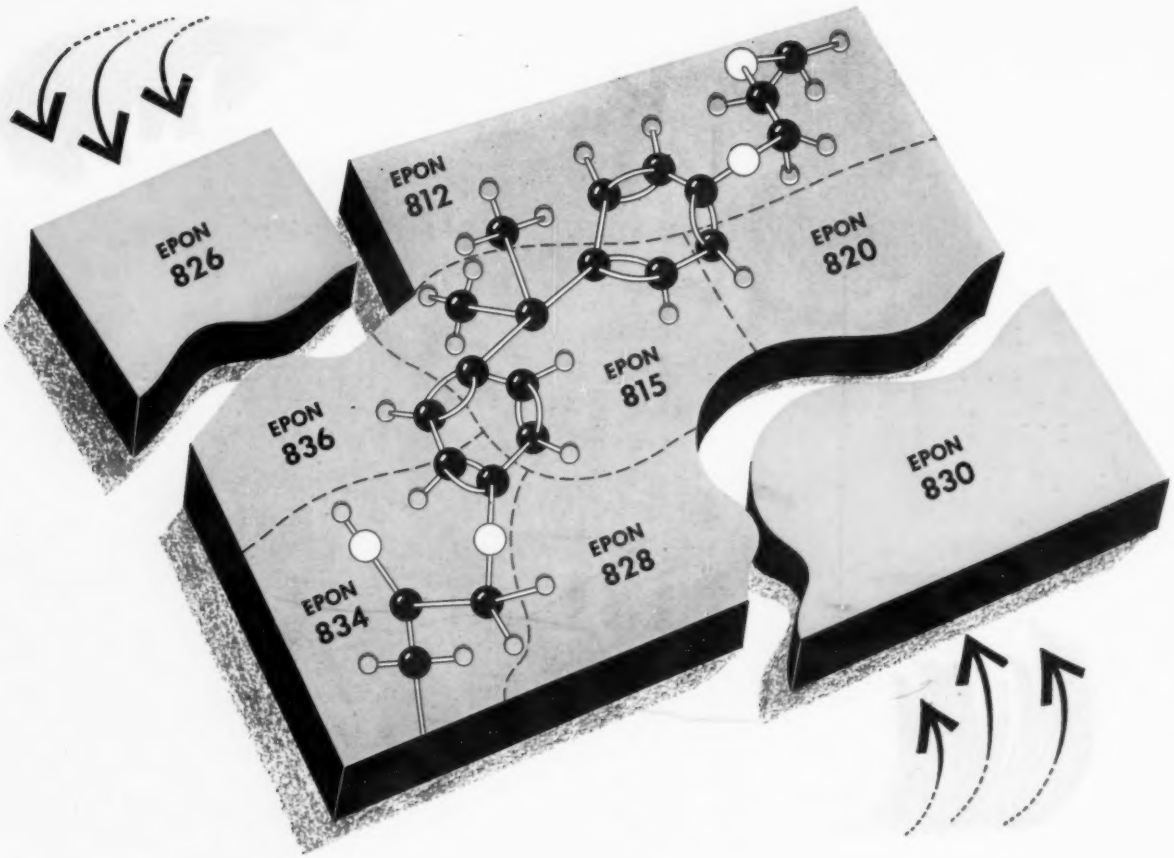

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Merry Christmas
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PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

December 1960, Vol. 6, No. 12

feature articles:

the outlook for 1961 ..... p. 31

How key men in the plastics industry view the coming year—materials, sales, potentials.

technical aspects of molding acrylics ..... p. 34

by J. F. MOORE

First half of a two-part article, it describes the properties of straight and modified acrylics, mold design requirements, and actual molding techniques. Many illustrations.

markets for flexible foams ..... p. 42

by P. B. NORTMAN

Current and potential markets for flexible urethane, vinyl, and latex foams are discussed and compared, with special emphasis on the polyether polyurethanes. Development of urethane foam is covered in detail, as well as structure of the foam industry, costs and prices, new markets, and futures. Market fields discussed include furniture, automobiles, packaging, clothing and textiles, rug underlays, toys and novelties, footwear, constructions, and industrials.

tiros II — plastics as satellite optics ..... p. 50

by RUSSELL DeWAARD

Radiometer in Tiros II is practically all plastic. Not much larger than a Christmas tree ornament, it may be able to tell you whether your Christmas will be white. Note size of radiometer in comparison with Christmas tree ornaments.

exploring fabrication techniques:

by L. J. ZUKOR

saving labor in plastics processing, specialized machines, hopper loaders ..... p. 56

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DOW Plastiatrics
DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

IMPACT ENERGY DATA GUIDES SELECTION OF PROTECTIVE PACKAGING MATERIALS

Today's packaging applications are unlimited, ranging from heavy industrial parts to fragile instruments. Though protective requirements may vary from product to product – including protection against heat, cold, water, dehydration–the one common to most packages is impact protection.

Regardless of the source of impact, or how the impact load is delivered, package contents must be cushioned in such a way that acceleration or deceleration at the moment of impact is kept below certain limits, depending on the contents' fragility. In evaluating packaging materials such as the Dow foam materials, Ethafoam*, Styrofoam®, and Pelaspan®, several related factors must be considered:

1–thickness of cushioning material
2–conformance to the shape of the object
3–velocity of the impact blow
4–force of the impact blow
5–temperature
6–amount of energy absorbed by the cushioning material
7–resiliency (springback) of the cushioning material

A camera or optical instrument, for example, would require far greater protection against impact than an electric motor. But precisely how much protection? To help packaging engineers answer this question, Dow Plastics Technical Service Engineers have developed extensive data on the dynamic cushioning properties of Dow foam materials.

The curves in Fig. 1 show the relationships between peak deceleration in "g's" (multiples of acceleration due to gravity) and static stress in psi, for 2-inch thick Ethafoam from varying drop heights.

Molded Pelaspan plastic package gives delicate microphone positive impact protection.

The equipment on which these studies were made is shown in Fig. 2. A loading head, mounted on a vertical guide, is dropped from a predetermined height onto a sample of the cushioning material under test. Attached to the loading head is an accelerometer which measures impact deceleration in "g's." Accelerometer output is recorded on the oscilloscope.

In this test, the weight and surface area of the loading head in contact with the test sample determine the amount of static stress exerted on the sample. By continually increasing the weight on the loading head, deceleration in "g's" vs. static stress in psi can be plotted. Once an initial evaluation has been made (factors 1 through 7, in column 1), data from the dynamic cushion tests can be used to select the packaging material which provides the proper degree of resilience, rigidity and energy absorption. The data will also be of value in package design, and in determining the optimum thickness of the foam material to be used.

Data from these and other continuing Plastiatrics Studies are available to packaging engineers and designers. These studies provide information not only on packaging, but on plastics properties, and on improved methods of design, molding and finishing of plastics. For information, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 1805DT12. *Trademark

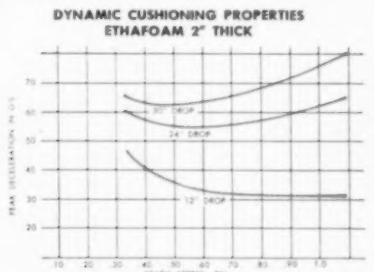

Fig. 1. Cushioning properties are plotted for varying drop heights.

Fig. 2. Dynamic cushion testing equipment for evaluating packaging materials.

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Letters to the Editors

Suggestion from a reader

Dear Sir:

Your September issue has been received and I have finished examining your excellent articles on extrusion and blow molding, including the evaluation of existing equipment.

As a suggestion, I am wondering if it might be possible for you to do the same thing in a future issue for the plastic sheet and film industry and the coated fabrics industry, including calenders, embossers, printers, coaters, and casting equipment. Also, it would be interesting to your readers, I am sure, if you could present annually figures on the various types of sheet, films, and coated fabrics materials, including widths, weights, volumes, and end uses.

Campbell Taylor, Jr., Director
of Marketing Research
Columbus Coated Fabrics Corp.
Columbus, Ohio

(Do any readers wish to second or comment on this suggestion?—Editor)

•

Market information

Sirs:

We are wondering if your market research work has determined the extent of sleeve bearing use of plastics in terms of pounds used, type of plastic, and dollar volume—both current and predicted uses.

What specific industries and product areas are involved and what plastic shapes and forms are required. We are particularly interested in what's happening with nylon, Delrin, and Teflon.

Leland W. Long
Johnson Bronze Co.
New Castle, Pa.

(We print this letter, one of many, which we receive almost daily requesting market information. Some are from plastics processors, some material suppliers, and some end users. All are interested in futures in plastics processing.—Ed.)

•

Local extruder firms—please note!

Sirs:

This letter concerns a new type of roofing—EDIT—which is currently being manufactured under license in various European countries. The head office is in Italy.

Our firm is the Canadian representative of Edit, and we have been asked by our principals to establish manufacture in the United States under license.

Edit profiles are made with rigid PVC, and are assembled, one onto another by special fastening clips. They can be used for industrial sheds, porches, kiosks, pavilions, cabanas, and partition walls.

U. S. extruders interested in such an arrangement should contact me.

G. A. Metcalfe
Coast to Coast Building
Specialties, Ltd.
Box 55, Unionville,
Ontario, Canada

•

Plastic toy auto manufacturers

Sirs:

We would very much appreciate receiving information on manufacturers or suppliers who might furnish us with about 10,000 toy, plastic autos one inch long by a quarter inch wide.

Jean Kohrt
Marken Educational Games
918 N. Wild Olive
Daytona Beach, Fla.

•

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identify of the writer will be withheld, if desired.

—The Editor

What to look for in January

PT's comparative data on compression and transfer molding machines.
This staff-compiled tabulation lists comparative specification data on machines which are currently available from domestic manufacturers.

•

Engineering features of 1961 compression and transfer presses. L. J. Zukor, Engineering Editor, PLASTICS TECHNOLOGY.
If you are planning to buy a new compression or transfer press, or are considering certain auxiliary devices to augment production or cut waste, you will be interested in this article.

•

Technical aspects of molding acrylics —Part II. J. F. Moore, Technical Rep., Rohm & Haas Co., Philadelphia, Pa.
The second part of an article begun in December. Injection molding of acrylics (standard and modified) generally falls into four categories: basic materials and their characteristics; gate, runner, and mold design requirements; techniques for molding the part; and tests for quality. A wide range of molding conditions is possible with the acrylics.

•

Surface quality of fiberglass-reinforced polyester moldings. W. J. Diamond, Senior Tech, Engr., Brunswick Co., Muskegon, Mich.
The growth of the glass-reinforced plastics field in many product lines has been retarded by limitations of surface quality. These are caused by entrapped air and inadequate resin-glass bond. Test results given are based on microscopic studies of specimens both before and after stressing. Two types of stress were used; a slow bending creep and a fast Izod-type impact.

•

Economies through bulk shipment of plastics. D. B. Semeyn, Customer Service Engr., Dow Chemical Co., Midland, Mich.
Shipment of resins in "carload" quantities provides savings to the fabricator in terms of efficiency and economy. The molder can benefit in raw material cost, warehouse space, materials-handling labor, spillage, and rejects caused by contamination of the materials.

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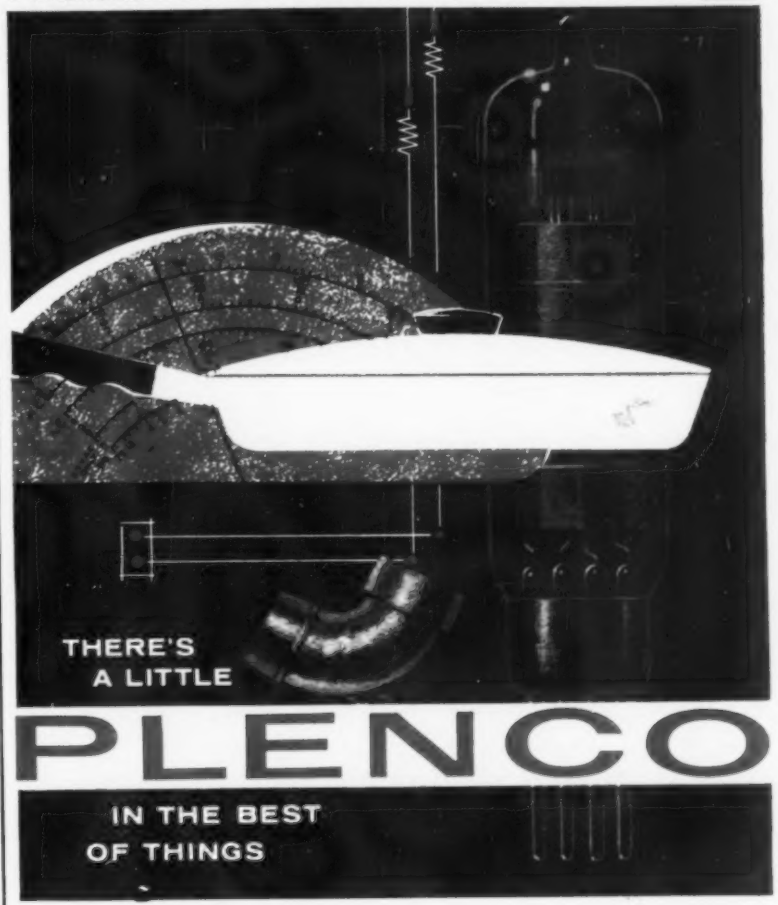

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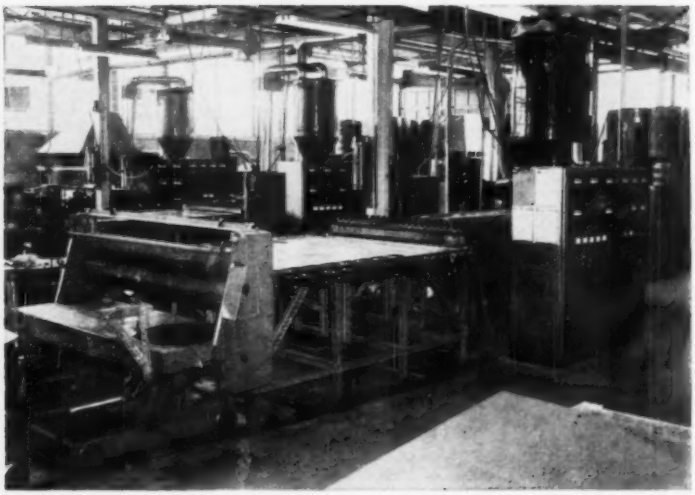
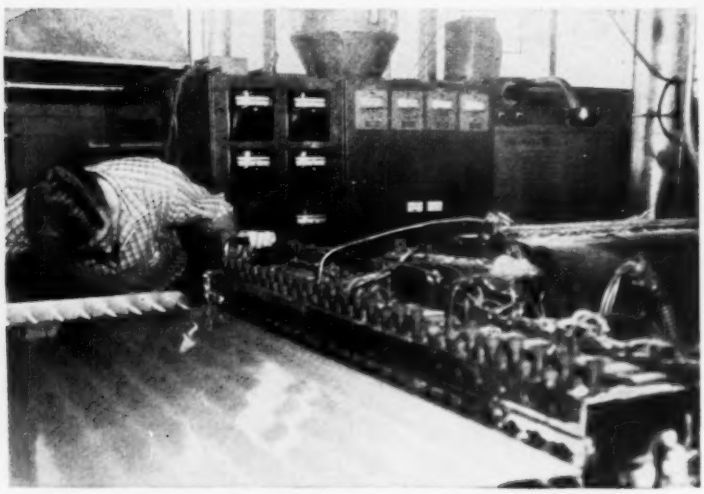
Wheelco Capacitrols are set to control a total of ten temperature positions for one of Cadillac's plastic extruders.



Granular plastic is heated to a flowing consistency as it passes through the barrels of Cadillac's extruders. Temperature across the dies must also be controlled to maintain uniform caliper and output.



Temperature is controlled in the hopper section, the 1, 2 and 3 zones, the extruder gate, and at five points across the width of the die. Here, the extruder is adjusted to control thickness of a plastic sheet.

This is Cadillac's reason for planning to continue specifying Wheelco Instruments . . . high quality plastic with uniform caliper.

Cadillac Specifies Wheelco

Series 400 Capacitrol

"Wheelco Instruments do the job and do it well" says George Carlyon, vice president-manufacturing of Cadillac Plastic & Chemical Company, Detroit, Michigan. "Since different temperatures are required in extrusion of plastics, a highly efficient heat control unit which facilitates rapid change for the different plastics is a must. The combination of satisfactory operation and good service have made Wheelco Instrumentation an integral part of plastic extrusion here at Cadillac." Wheelco offers a complete line of automatic process control instrumentation for your plastic processing requirements. Contact your nearest Wheelco sales and service office or write direct for complete information.

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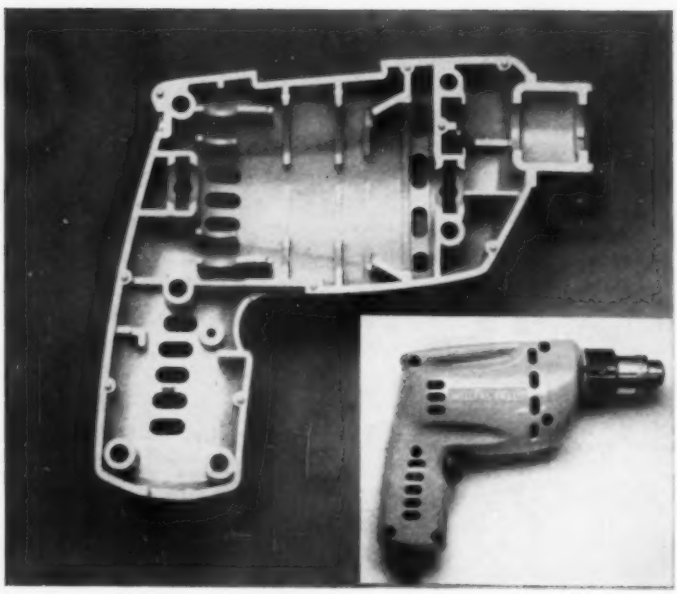
PLASTICS PROSPECTS

Expanding use of ZYTEL® opens new market opportunities for molders

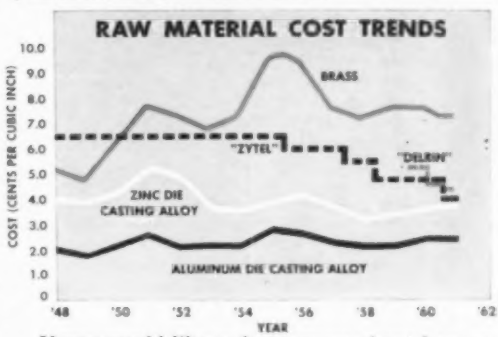


The need for improved product performance and lower costs is turning more and more manufacturers toward plastics as replacement materials for metals. Engineering plastics such as DELRIN® acetal resin and ZYTEL® nylon resins are opening vast new sales opportunities for injection molders.

The story of the new Millers Falls drill housing, at left, is a case in point. The total opportunities for the economical use of ZYTEL in the field of small power tools have hardly been tapped. In sporting goods, plumbing fixtures, mechanical applications, hardware items and many other areas, the growth of applications of ZYTEL is rapid, and offers molders opportunities for an expanded volume of business.

As prices of DELRIN and ZYTEL have continued to drop and those of aluminum, zinc, brass and other metals have continued upward, the market for parts of plastic has expanded. The chart shows these materials-cost trends.

Since parts molded of plastic require little or no finishing in comparison with costly finishing operations on metal, even when only moderate finishing is required, the completed-part cost in plastic is often lower. When the properties of the plastic fit, the business is there.



If you would like to know more about how to find business in this expanding market, please write to: E. I. du Pont de Nemours & Co. (Inc.), Dept. FF-12, Room 2507Z, Nemours Building, Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P. O. Box 660, Montreal, Quebec.

POLYCHEMICALS DEPARTMENT

New Millers Falls drill housing of ZYTEL® brings design improvements

The insulating properties of ZYTEL nylon resins make possible a drill housing that helps protect against shock hazards. In addition, this rugged and durable housing of ZYTEL is 20% lighter in weight than a comparable housing of aluminum. It is self-extinguishing. It stays comfortable to the touch in hot or cold weather, even after prolonged use. The two halves of the drill housing are molded quickly and easily by the molder. The choice of ZYTEL 31 assures good dimensional stability of the moldings, and permits a perfect match of each half for screw inserts, assembly and flange matings. No machining is necessary.

The manufacturer, Millers Falls Company, of Greenfield, Mass., reports that extensive field tests of the new drill have proved its excellent service life. The new drill also has a black collar and lock switch made of Du Pont DELRIN® acetal resin—chosen for its exceptionally good dimensional stability.

Du Pont's problem-solving engineering materials:

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☐ **2. HOBBS "CHP" WINDER WITH SYNCHRONIZATION (NTJ).** Preset tension maintained during frequent speed changes through a 3-phase synchronizing generator, driven by main machine. Speed of generator varies with that of main machine. Frequency of output current and speed of motor varies accordingly, resulting in essentially constant tension. Unit has higher ratio of speed change and diameter buildup than standard unit, a ratio of 1:100 being obtained on some material.

☐ **3. HOBBS APF PROGRESSIVE FRICTION WINDER (APF).** Preset tension automatically maintained with extreme accuracy, during a roll buildup of 8:1, through a series of overriding friction clutches running in oil. Driven from the main machine, winder changes speed in proportion and still maintains constant tension. Required torque increase is sensed directly from the web (no dancer rolls).

☐ **4. HOBBS DC FIELD CONTROL WINDER SYNCHRONIZED WITH DC MACHINE DRIVE.** Preset tension automatically maintained (with accuracy of ±2% over roll buildup of 8:1, or even 10:1) by controlling the field current through a saturable reactor. Strength of the field is automatically adjusted to hold the armature current constant for any tension setting.

☐ **5. HOBBS DC FIELD CONTROL WINDER — WITHOUT DC MACHINE DRIVE.** For situations where synchronization is not necessary. Except for absence of synchronization, winder operates as above. An independent adjustable DC supply is provided for the automatic field control.

☐ **6. HOBBS DC FIELD CONTROL WINDER SYNCHRONIZED WITHOUT DC MACHINE DRIVE.** Synchronized winding characteristic is as described in paragraph 4. However, the armature voltage is automatically controlled by a signal from a tach generator on the main machine. This operates through a magnetic amplifier and saturable reactor circuit.

☐ **7. HOBBS DC SPEED CONTROL WINDER.** For use when ranges of speed, width and diameter are beyond the capacity of a tension control winder. This unit provides synchronization and near zero constant tension. A dancer roll controls a transducer, regulating the armature voltage of a DC shunt motor, thus determining the output speed of the motor. Static control achieved with a saturable reactor.

Check the type of Hobbs winder most suitable for YOU and ask us to figure on your requirements.

If you don't know, tell us your problem and ask us to make recommendations.

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U.S.I. POLYETHYLENE NEWS

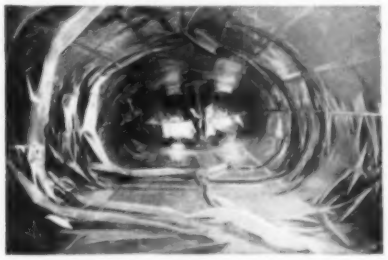
A series of advertisements for plastics and packaging executives by the makers of PETROTHENE polyethylene resins

Disposable food-grade polyethylene liners are being used within large collapsible containers to haul edible liquids—milk, fruit juices, molasses and vegetable oils. The containers, recently introduced by a California company, can be carried on any van or flat-bed trailer, including refrigerated vans. They come in 22-, 30-, or 34-foot sizes, having capacities of 2,750, 4,000 and 4,600 gallons, respectively.

Following delivery, the disposable polyethylene liner is removed and the container rolled into a compact package, freeing the vehicle for a return trip with dry freight. To use the container again, it is unrolled on floor of truck and inflated. A sanitary poly liner is then easily spread within the container and also inflated—ready for another load.

Van-Tank is first unrolled on floor of trailer, inflated with low pressure air.

Sanitary plastic liner is quickly spread, with no contact with interior of liner.



Liner itself is then inflated, and Van-Tank is ready to receive its load.

Silver polish in a polyethylene tube stays creamy, won't dry out or cake up, and is more convenient to use. The exact amount needed can be dispensed right where it's wanted. And, when the squeeze is relaxed, excess is drawn back by the tube. New tube is printed in blue and red on white background, has a stand-on cap.

U. S. I. Introduces Two New PETROTHENE Resins For Injection Molding

Top Quality Polyethylene Resins Sell for New Low Price of 26¢ A Pound

U.S.I. has developed two new polyethylene resins tailored exclusively to the needs of injection molders producing toys, novelties and housewares. Called PETROTHENE 117 and PETROTHENE 213, they can be obtained from U.S.I. at 26¢ a pound—a record low price for top quality polyethylene resins.

New PETROTHENE resins are tailored exclusively for injection molded housewares, toys, and novelties.

PETROTHENE 117 (density 0.917 to 0.920, melt index 7.0 to 10.0) provides good appearance, extreme toughness and high gloss. Items molded from it can be expected to have low to medium stiffness.

PETROTHENE 213 (density 0.921 to 0.925, melt index 7.0 to 10.0) produces moldings of excellent appearance, good toughness and *very* high gloss. End products obtained are characterized by medium to high stiffness.

Processing Properties

PETROTHENE 117 and 213 are high-flow polyethylenes, so permit short injection molding cycles. Thus, economical production rates are possible. Molders of colored items will appreciate the ease of pigmentation offered by both new resins. They combine readily with most pigments by either dry blending or homogenization.

Optimum molding conditions will vary with equipment used and end-use requirements; these should be determined in each application. Technical assistance in determining proper conditions for specific applications is available on request from U.S.I. Technical Service Engineers. Or, for additional technical data on PETROTHENE 117 or 213 write Technical Literature Department, U.S.I., 99 Park Avenue, New York 16, N. Y.

Booklet Details Uses For Powdered Polyethylene

U.S.I. has published an 8-page booklet which explains in detail how U.S.I.'s finely divided or powdered polyethylene, introduced under the trade name "MICROTHENE", is used. Applications covered—many of which are not feasible with conventional polyethylene—include metal, textile, and glass; large moldings; and miscellaneous uses such as rubber additive, wax additive, and anti-tack agent. Data are also given on the sizes and grades of MICROTHENE polyethylene resins available. Copies may be obtained by writing to Technical Literature Department, U.S. Industrial Chemicals Co., 99 Park Avenue, New York 16, N. Y.

IF YOU WOULD LIKE further information on any developments reported in U.S.I. Polyethylene News, U.S.I. will be glad to send you the names of the manufacturers. U.S.I. also invites you to send information on your new developments for possible inclusion in the News.

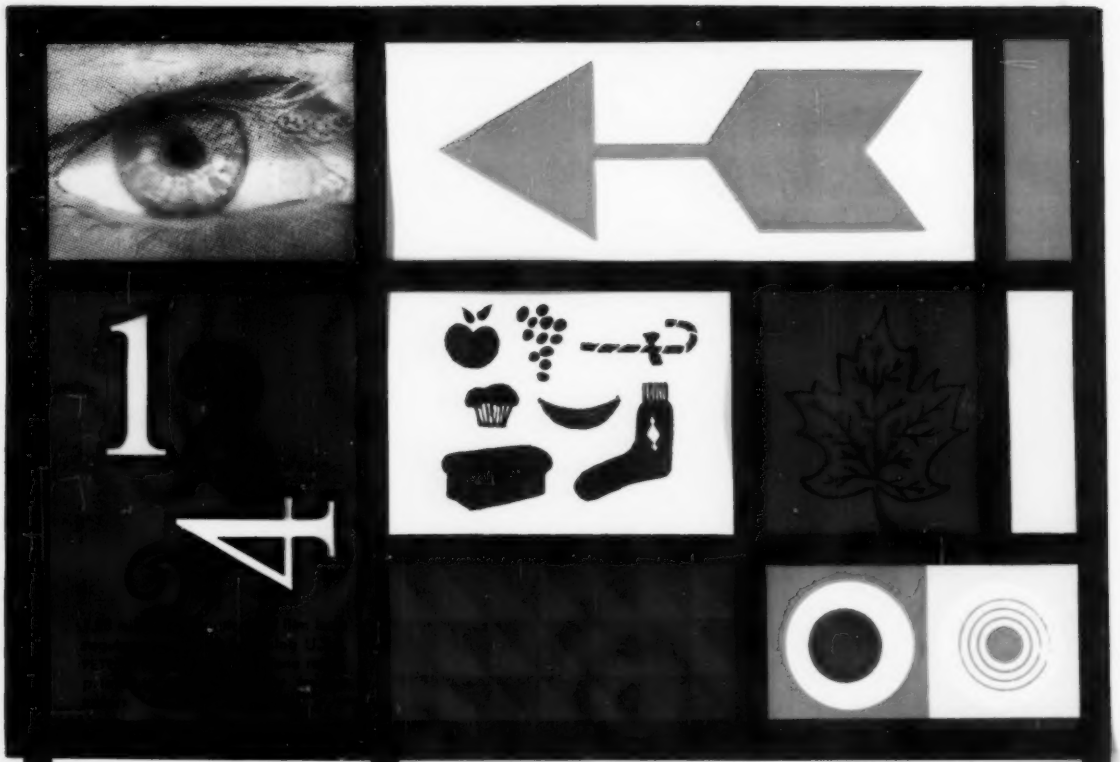
Address the Editor,
U.S.I. Polyethylene News, U.S. Industrial Chemicals Co.,
99 Park Avenue, New York 16, New York.

Flower Pots Made from Coconut Husk Fibers with Aid of Polyethylene

In Puerto Rico, polyethylene film is being used as a mold liner in the production of plant pots from "Coir" fibers—the commercial name for the product obtained by defibering the husk of the coconut. These fibers—which are heavily lignified—yield potash and phosphoric acid on decomposition, so offer considerable value as fertilizer. Urea formaldehyde serves as a binder.

The developer of this process reports it has been in successful use for two years, credits polyethylene film with making it possible. Illustration shows how he lines mold cavity and punch with polyethylene.

Punch, mold cavity, and finished plant pot made of coconut fiber with help of polyethylene film.



Colorful Polyethylene

. . . offers your customers powerful sales advantages

When you supply your customers with polyethylene film, you provide them a packaging material that offers three important sales advantages. First, the film's toughness provides superior protection for packaged goods. Second, its clarity, high gloss and soft, natural flexibility add a look of quality and a clear unobstructed view of the product. Third, the film can easily be printed with colorful designs, sales messages and product information . . . producing brilliant showcases that draw attention to your customers' products.

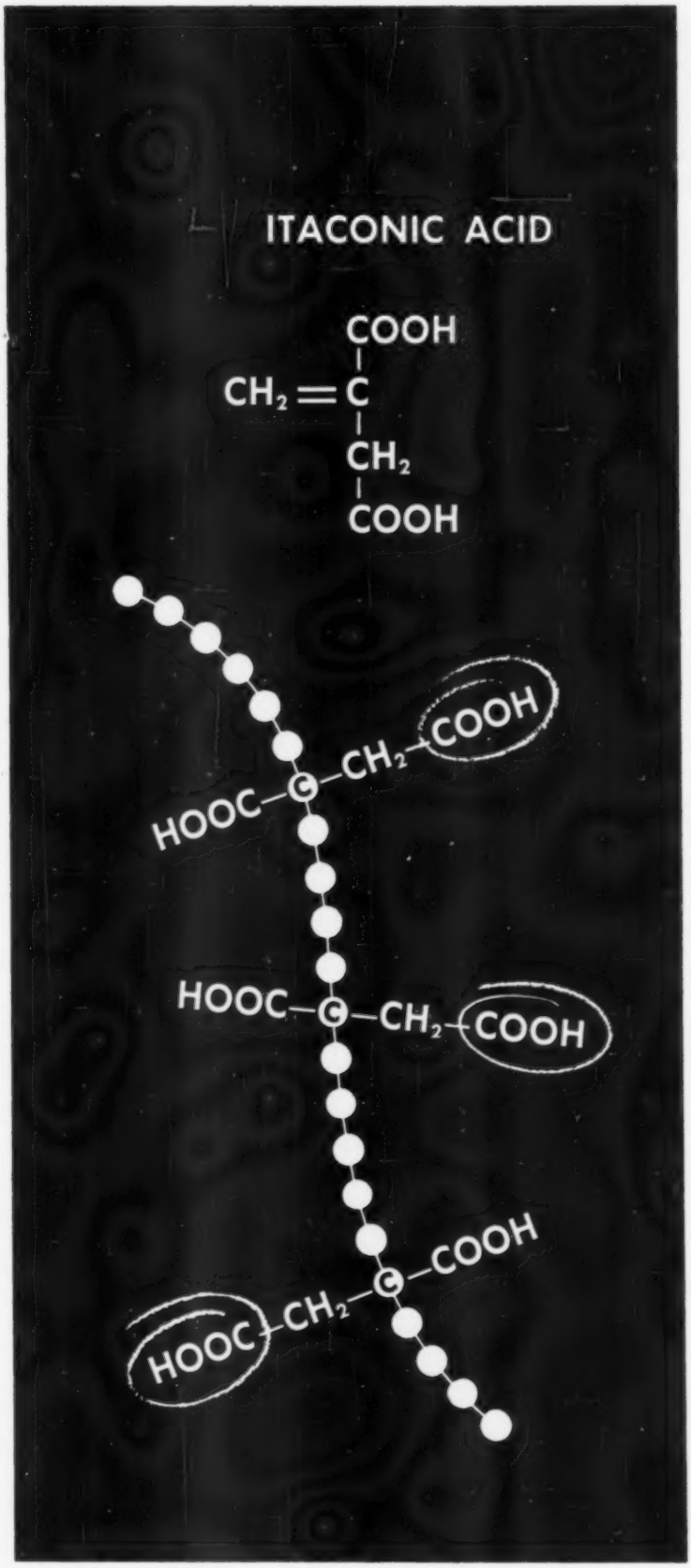
Polyethylene film can be printed at high speeds, with sharp registration and good ink adhesion. Packages can be formed on automatic machinery and sealed by heat.

U.S.I. produces a number of PETROTHENE® polyethylene resins ideally suited for producing clear or printed packaging film. These resins offer excellent drawdown properties and a superior combination of toughness and clarity in finished film.

A helpful new U.S.I. booklet, "Printing On Polyethylene", is available upon request. It contains information on film treatment, printing techniques, inks, and field test procedures. For your copy, or for information about PETROTHENE resins, contact your nearest U.S.I. sales office or write to the address below.

U.S.I. is helping to expand your polyethylene film market with ads, similar to this one, addressed to the package-using industries. These ads are designed to pre-sell your potential customers on the sales appeal and other advantages of polyethylene film packaging.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities



ONLY ONE ACIDIC MONOMER

OFFERS THE EXTRA-ACTION β-CARBOXYL GROUP

BUILD IMPROVED POLYMERS WITH PFIZER ITACONIC ACID

Separated from the polymer chain by a methylene group, the β-carboxyl group shows unique activity in imparting specific adhesion to selected substrates, or improving emulsion stability. Available in commercial quantities and at commercial prices, Pfizer Itaconic Acid provides the unique advantage of this second, more active carboxyl group. Let us send you complete details today.

CHAS. PFIZER & CO., INC.,
Industrial Chemical Development Dept.
630 Flushing Ave., Brooklyn 6, N. Y.

Manufacturing Chemists for over 100 Years

Science for the Pfizer world's well-being

Branch Offices: Clifton, N. J.; Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Tex.; Montreal, Canada

1.25 mil cast polyethylene film from regular production run using U.S.I. PETROTHENE 218 polyethylene resin, printed flexographically in six colors.

Colorful Polyethylene

. . . offers your customers powerful sales advantages

When you supply your customers with polyethylene film, you provide them a packaging material that offers three important sales advantages. First, the film's toughness provides superior protection for packaged goods. Second, its clarity, high gloss and soft, natural flexibility add a look of quality and a clear unobstructed view of the product. Third, the film can easily be printed with colorful designs, sales messages and product information . . . producing brilliant showcases that draw attention to your customers' products.

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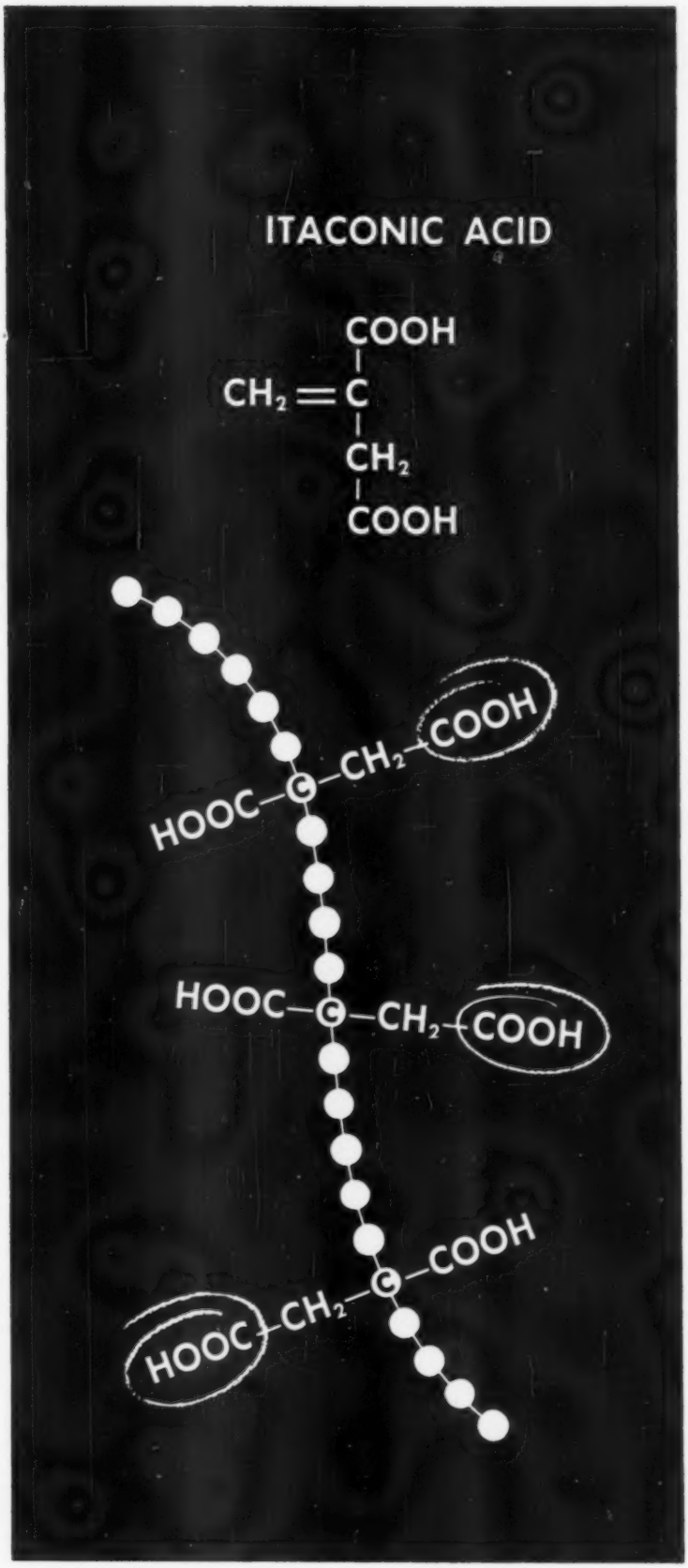

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Manufacturing Chemists for over 100 Years

Science for the Pfizer world's well-being

Branch Offices: Clifton, N. J.; Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Tex.; Montreal, Canada

NEW

LOW-ORIENTED STYRENE MAKES THIN-WALLED CONTAINERS UP TO 4 TIMES TOUGHER!

Even at -20°F. this BAKELITE Brand medium impact styrene can give almost four times the impact strength of conventional medium impact styrenes. The secret—low-orientation.

IN standard laboratory specimens all good medium impact styrenes check out about the same. That's how they got their name. But in an injection molded thin-walled piece? A different story. Serious loss of impact strength has been found across the "lines of flow" set up in any injection process. Remember, the piece is exactly as strong as its weakest section.

Until recently this strength loss was a fact of life we just accepted. But now, using BAKELITE Brand TMD-9020, a low oriented medium impact styrene, you can take advantage of *all* the strength originally built into the material. You get the translucency, the economy of a medium impact styrene. And you can get almost four times the molded strength of conventional materials of this type, even at temperatures as low as twenty below zero!

Containers and snap-on lids made of low-oriented TMD-9020 by Parker-Kalon. Division of G. A. T. X.

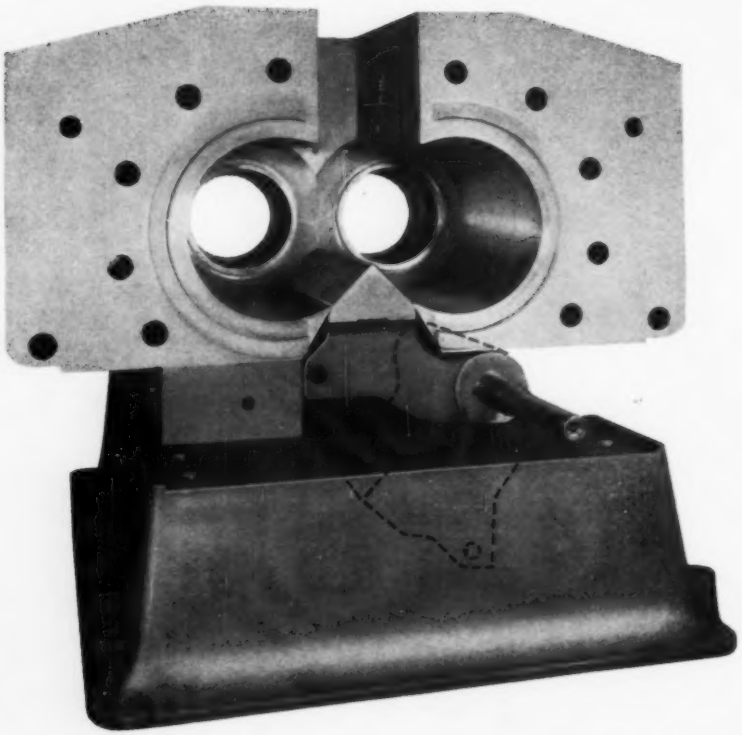
In standard laboratory "ball drop" test, regular medium-impact styrene (**left**) breaks under 4-in. drop, while new low-oriented styrene (**right**) takes ball dropped four times higher. Both samples were pre-chilled to 20° below zero F.

Think what this means to the package designer and consumer. Products can often be identified without opening the package. And these packages take to the kind of rough treatment the more fragile see-through packages could never begin to withstand. Shoppers can handle them without special care, dump them in a shopping cart, use them again at home as often as they wish.

Packaging suppliers who keep ahead will soon be offering molded plastic boxes and other containers made from this new BAKELITE Brand medium-impact styrene. Be sure you're at the head of the line. Get an idea of how low-oriented styrene will perform in *your* packaging. Remember it—BAKELITE Brand medium-impact styrene TMD-9020. It's the forerunner of other low-oriented BAKELITE Brand styrenes soon to come in other impact-resistant grades. Write today to Dept. GM-105, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

BAKELITE and UNION CARBIDE are registered trade-marks of Union Carbide Corporation.



ONE OF MANY WAYS

Banbury® mixer design meets the needs of plastics processors

Using knowledge gained through close association with plastics manufacturers, Farrel is continually improving Banbury mixer design. Shown above is one recent innovation: the hydraulically operated drop door.

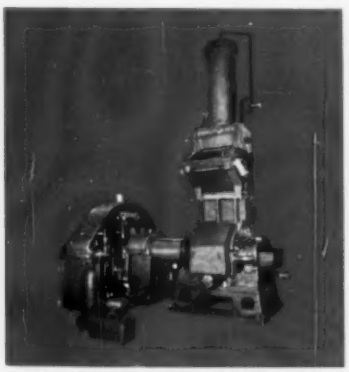
Hinged so that its tapered edge swings up to make line contact with the mixing chamber, this design eliminates the leakage inherent in sliding doors. There are never any "rattails" left to contaminate the next batch. Its quick action (under 2 seconds) is valuable when working with sensitive plastics at critical temperatures.

Banburys come in two types – with cored or spray sides – to meet any processing need. Capacity, rotor speed, pressures and types of surfacing material – whether Stellite, chrome-plate, stainless steel or dual-metal for lining – are dictated by the application. Standard features include roller bearings and self-sealing dust stops.

Send for bulletin 207. It will bring you up to date on Banbury design.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT
Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
Sales Offices: Ansonia, Buffalo, Akron, Chicago, Los Angeles, Houston, Atlanta
European Office: Piazza della Republica 32, Milano, Italy

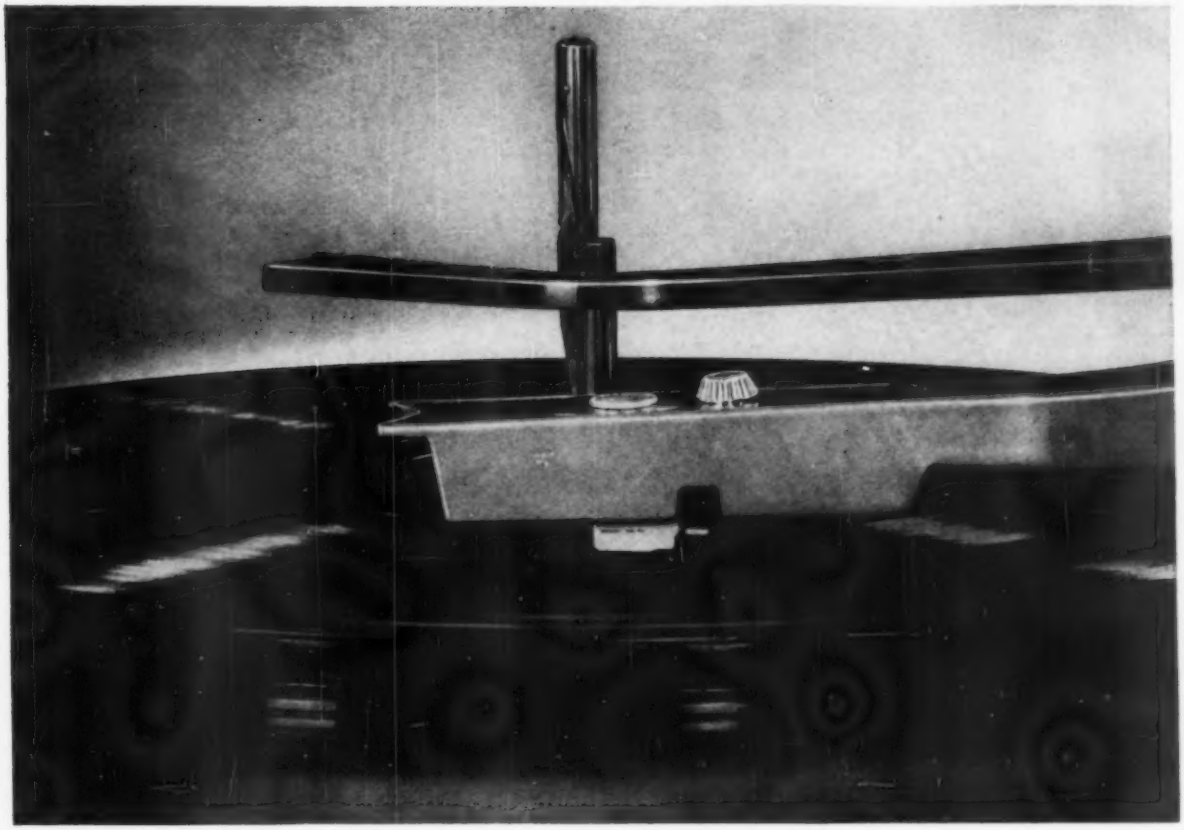
FARREL®



Left: Size 9D Banbury with spray-cooled sides for most efficient cooling can also be used with up to 15 pounds of steam for moderate heating.

Right: Size 3D Banbury with cored sides, recommended for use where high machine temperatures are necessary.

FB-1206



For records...

Let LECTRO® 78 stabilizer help you maintain maximum physical properties with vinyl resins

LECTRO® 78 is a basic lead stabilizer developed for use with all types of vinyl chloride polymers.

Manufacturers of both filled and unfilled vinyl phonograph records find Lectro 78 an outstanding stabilizer.

Its high heat stability maintains the maximum physical properties attainable with vinyl resins. As a result, their records have superior wear properties . . . highest fidelity . . . lowest noise level. And because of the compatibility and good stabilizing action of Lectro 78, there's no annoying problem of surface streaking.

Besides phonograph records, there are many other applications where Lectro 78 can simplify production, improve performance. This stabilizer is exceptionally well suited for high temperature insulation, rigids and other compounds. Its easy dispersion and non-gassing characteristics combine to make this stabilizer an excellent choice to help you meet a variety of severe processing and service conditions.

For example . . . in tests made according to Underwriters' Laboratory procedures on T, TW, 90°C and 105°C coated wire, Lectro 78 displays high volume resistivity over a range of temperatures. What's more, it shows outstanding moisture resistance.

And that's not all. Lectro 78 stabilizer is an efficient basic lead vulcanizing agent for chlorosulfonated polyethylene... has good compatibility with most plasticizers commonly used in electrical insulation . . . requires less lubricant than most other electrical stabilizers. Use the convenient coupon below to get valuable additional information on Lectro 78 stabilizer. A data sheet can be yours by return mail.

LECTRO® 78 *A Chemical Development of*

National Lead Company

111 Broadway, New York 6, N. Y.

KC-6294

NLC

National Lead Company: General Offices, 111 Broadway, New York 6, N.Y.
In Canada: 1401 McGill College Avenue, Montreal.

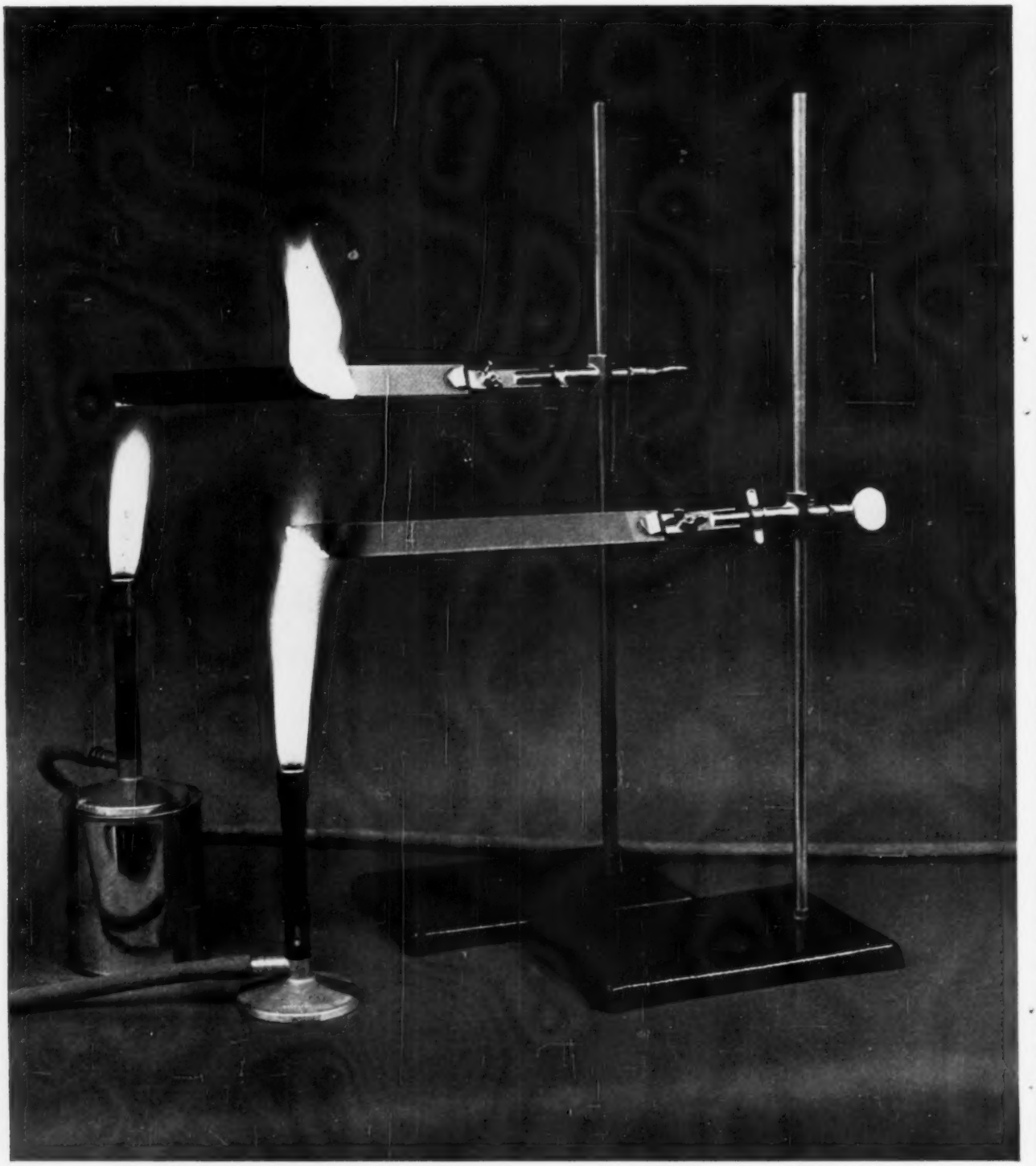
Gentlemen: Please send your new Data Sheet for LECTRO® 78, basic lead stabilizer for use with all types of vinyl chloride polymers.

Name_____ Title_____

Company_____

Address_____

City & Zone_____ State_____



AROCLORS are COMPATIBLE with virtually all plastics resins • polyvinylidene chloride • cellulose acetate propionate • polyvinyl acetate • chlorinated rubber • ethyl cellulose • benzyl cellulose • polystyrene • nitrile rubber • phenolics • polyamides • epoxies • acrylics • urethanes • polyesters • polyethylene • nitrocellulose • polyisobutylene • styrene-butadiene • polyvinyl butyral • polyvinyl chloride • cellulose acetate butyrate

HOW TO "BUILD IN" HIGH RESISTANCE TO FIRE AND CHEMICALS WITH LOW-COST AROCLOR® PLASTICIZERS AND RESIN EXTENDERS

AROCLOR *chlorinated* polyphenyls—liquid or solid—offer remarkable *inertness*. They don't burn, evaporate, hydrolyze, or oxidize. They defy strong acids and alkalies. They blend readily with nearly all resins, solvents, plasticizers, and other plastics-compounding ingredients. You can choose from 13 standard AROCLORS—to impart outstanding flame retardance, chemical resistance, and other desired properties to your plastics compounds and protective coatings . . . *at low cost.*

NONBURNING EPOXIES

Aroclors are fully compatible with epoxy resins. Combined with a small amount of antimony oxide, they produce *nonburning* compositions. Aroclor 5460 yields epoxies with optimum compressive strength. Aroclor 1221 greatly improves flexibility.

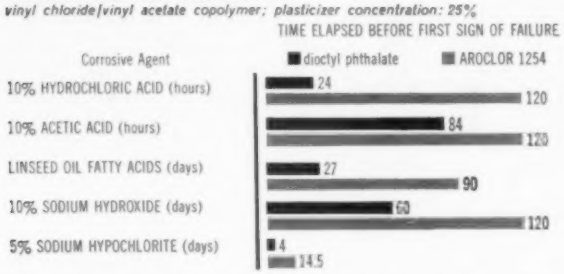
	AMINE-CURED EPOXIES		PHTHALIC ANHYDRIDE-CURED EPOXIES	
formulation	**control**	**modified**	**control**	**modified**
liquid epoxy resin	100	100	100	100
diethylenetriamine	13	13	...	...
phthalic anhydride	...	...	75	75
antimony oxide	...	5	...	5
DMP 30 (Rohm & Haas)	...	...	0.1	0.1
AROCLOR 1260	...	15	...	...
AROCLOR 5460	...	...	...	15
properties				
compressive strength, *psi*	43,000	38,150	23,400	40,700
flexural strength, *psi*	20,100	22,100	16,900	19,000
heat distortion, °C.	117.5	92	143	135
FLAMMABILITY— *inches per minute* (ASTM D635-56T)	0.82	NON-BURNING	0.6	NON-BURNING

EXTENDERS FOR PVC

Aroclors are especially effective as secondary plasticizers or extenders for polyvinyl chloride. Aroclor 1262, used 1:3 with dioctyl phthalate, sharply reduces migration to nitrocellulose lacquers. All Aroclor compounds can be used to improve the chemical resistance of vinyl chloride–vinyl acetate coating formulations.

TYPICAL CHEMICAL RESISTANCE*

vinyl chloride/vinyl acetate copolymer; plasticizer concentration: 25%



***Plotted from independent evaluation data by the Northwestern Paint and Varnish Production Club** (The Official Digest, Nov. 1955).
Conclusion: **"The Aroclor 1254 had the best all-around chemical resistance."**

SELF-EXTINGUISHING POLYETHYLENE

Aroclor 5460 gives self-extinguishing, low-density polyethylene *with minimum effect on tensile strength or "memory."* Aroclor 5460 substantially improves heat stability, too, compared with other common flame retardants.

LOW-DENSITY POLYETHYLENE

formulation	**control**	**modified**
polyethylene	100	70
antimony oxide	....	10
AROCLOR 5460	....	20
properties		
melt index	1.96	6.2
% elongation	655	650
tensile strength, *psi*	2130	1710
yield strength, *psi*	1395	1300
FLAMMABILITY— *inches per minute*	7.1	SELF-EXTINGUISHING

NEW BOOKLET **gives the facts about "Aroclor Plasticizers" . . . compounding procedures, performance data, property tables, specific formulas. It tells how versatile AROCLORS could be your answer for better compounds at lower cost. Mail the coupon today**

Monsanto

Monsanto, maker of more plasticizers than any other company, provides these benefits to customers:

precisely right plasticizer systems

mixed-shipment savings

able technical help in depth

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
Department 2714-A, St. Louis 66, Missouri

Please send me:

( ) PL-306, "AROCLOR PLASTICIZERS"

( ) CS-14, "AROCLOR PLASTICIZERS IN EPOXY RESINS"

I'm interested in Aroclors for..... resins.

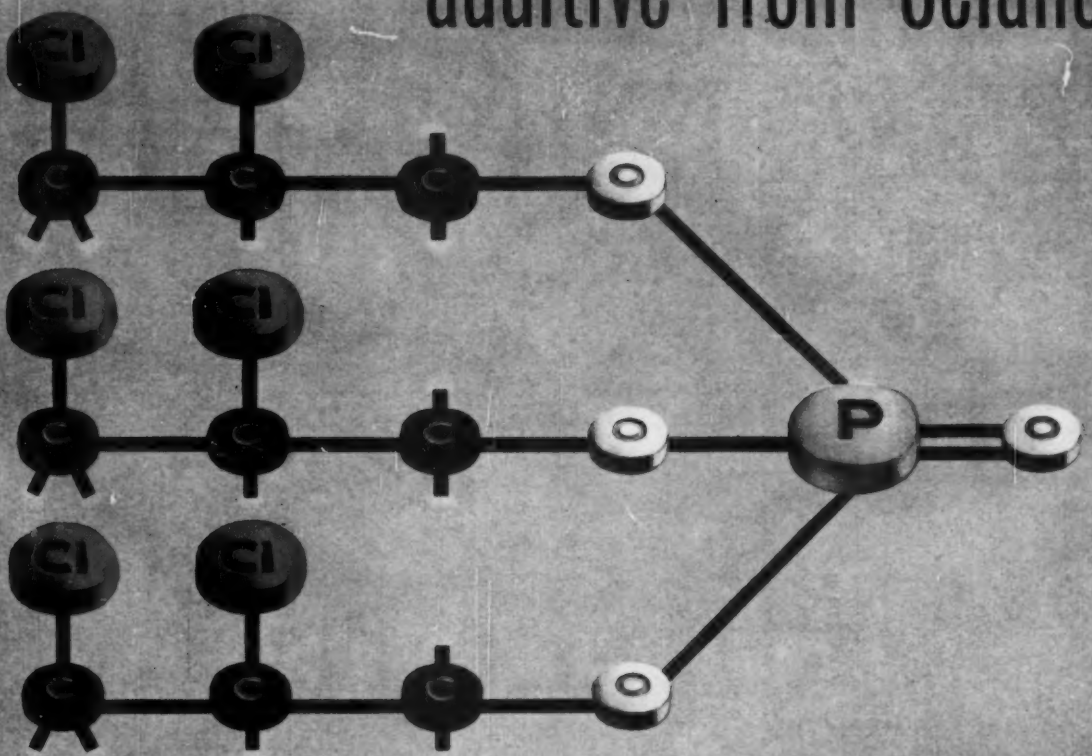
NAME.....

TITLE.....COMPANY.....

STREET.....

CITY.....ZONE.....STATE.....

a new fire-retardant additive from Celanese



CELLUFLEX FR-2 TRIS (DICHLOROPROPYL) PHOSPHATE

Latest in the family of Celanese phosphate-based plasticizers. Celluflex FR-2 is a prime fire-retardant additive for urethane foams, phenolics, polyesters and other plastics, both thermoplastic and thermosetting. The high chlorine (49%) and phosphorus (7.2%) contents are a measure of its ability to suppress flame.

Celanese, pioneer in products designed to meet the growing need for flame resistance, offers Celluflex FR-2 in quantities to fill all your requirements. For specifications, prices and delivery data, write to: Celanese Chemical Company, a Division of Celanese Corporation of America, Dept. 564-L, 180 Madison Avenue, New York 16, N. Y.

Celanese® Celluflex®

Celanese CHEMICALS

In Canada: Canadian Chemical Company, Limited, Montreal, Toronto, Vancouver
Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N. Y.

WHITE means clean, bright, new...

WHITE is eye appeal...

WHITE says "buy me"

GLIDDEN ZOPAQUE®
TITANIUM DIOXIDE

Once a substitute, now plastic is a *desired* quality material. And Glidden has helped plastics to progress.

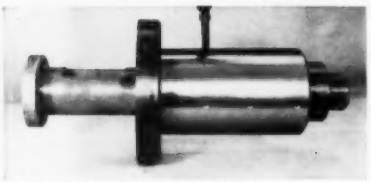
The optical properties of Glidden *Zopaque* Titanium Dioxide—high opacity, hiding strength and tinting power—are helping to sell countless plastic products, from radio shells, pencils, cosmetic bottles and upholstery, to floor tile that will outlast the building it's put into.

Glidden *Zopaque* helps production, too. It's easily dispersible in plastic formulations. Write now for details about ways Glidden *Zopaque* Titanium Dioxide can help you make . . . and sell . . . your plastic products.

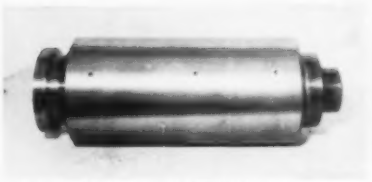
THE GLIDDEN COMPANY
FINEST PIGMENTS FOR INDUSTRY
Chemicals Division • Pigments and Color Department
Baltimore 26, Maryland

(This advertisement is printed on paper stock containing Glidden *Zopaque* Titanium Dioxide.)

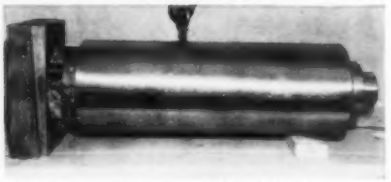
HEATER PROBLEMS ARE OUR BUSINESS!



8 oz. Fellows.....$2150.00



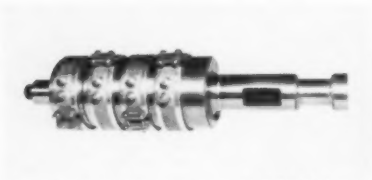
12 oz. Impco.....$2750.00



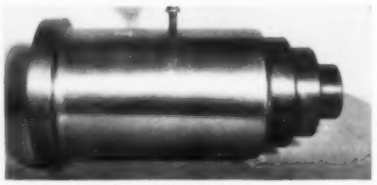
20-24 oz. Watson.....$4700.00

No matter what the make or model of your

4 oz. Moslo.....$1325.00

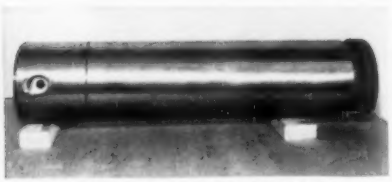


2-1/2 oz. Van Dorn.....$1155.00

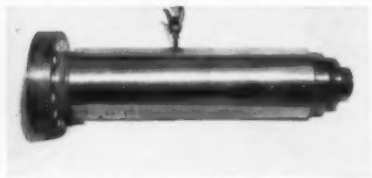


8 oz. Reed.....$1198.00

INJECTION MOLDING MACHINE



12 oz. Lester.....BVRF $2950.00

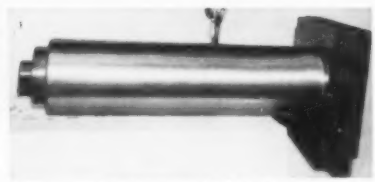


18 oz. Lombard.....$3850.00

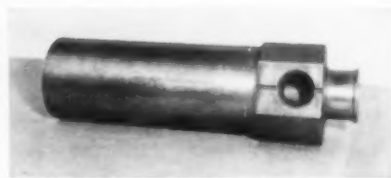
6 oz. Lewis.....$2150.00

Costs can be cut.....Production improved with

18 oz. 300TC Reed.....$3219.00



32 oz. Watson.....$4650.00



3 oz. Stokes.....VRF $1495.00

IMS Uniform Design Replacement Cylinders expressly built to solve your molding problems!

Nomenclature: Original Manufacturers.

Free

on your letterhead request, a personalized folder of typical IMS Stock Model Heaters complete with prices and specifications!

IMS

REPLACEMENT HEATING CYLINDERS

INJECTION MOLDERS SUPPLY CO., INC.

17601 SOUTH MILES ROAD • CLEVELAND 28, OHIO • LUdlow 1-3200

NEW FROM ENJAY

HEXYL ALCOHOL

● A raw material for the chemical industry

SPECIFICATIONS FOR HEXYL ALCOHOL

Purity, as Hexyl Alcohol (Wt. Per Cent)	min. 98.0
Specific Gravity (20/20° C.)	min. 0.819
	max. 0.821
Acidity as Acetic Acid (Wt. Per Cent)	max. .001
Color (Pt—Co)	max. 10
Water (Wt. Per Cent)	max. 0.10
Carbonyl Number (Mg KOH/g)	max. 0.2
Distillation: °C.	
Initial	min. 149
Dry Point	max. 158
Appearance	Clear and free of suspended matter

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This Month in Brief

Molding Acrylics - Part I of a two-part article on the injection molding of both standard and modified acrylics. Factors to be considered include the basic materials and their properties; gate, runner, and mold design requirements; actual techniques; and quality testing.

Past, current, and potential markets for flexible foams - vinyl, foam rubber, and urethane - with particular emphasis on the latter. This article is by a well-known market consultant who suggests areas of possible development, especially in the automotive and packaging fields.

The Outlook for 1961 - a staff-compiled analysis of the plastics industry business for the coming year, based on predictions by company spokesmen.

Just-orbited Tiros II may be able to tell you whether or not it will be a white Christmas, thanks to a small plastic (Mylar) device which is about the size of a Christmas tree ornament. See the Barnes article on a two-station radiometer.

The Editorial this month discusses a new type of article which we have added to our features. This particular one is on statistics (see above); however, future articles may concern other problems of the processor as a business man, not just a molder with technical problems. Such articles will not come at the expense of our original plans to carry technical articles on processing problems, but as adjuncts.

Exploring Fabrication Techniques concerns devices for saving the processor time and money. One is a specialized machine for vacuum forming which self-grommets thermoplastic sheet. It is capable of conduction heating, blowing, forming, and shearing. The other is a hopper loader system for vacuum conveying.

Our staff feature is entitled "Urethanes Aid Failing Hearts." Goodyear has developed a low-cost technique for fashioning heart valves for cast urethane, and the molds for same. Goodrich has been doing experimental work with animals, replacing heart valves with Estane polyurethane.

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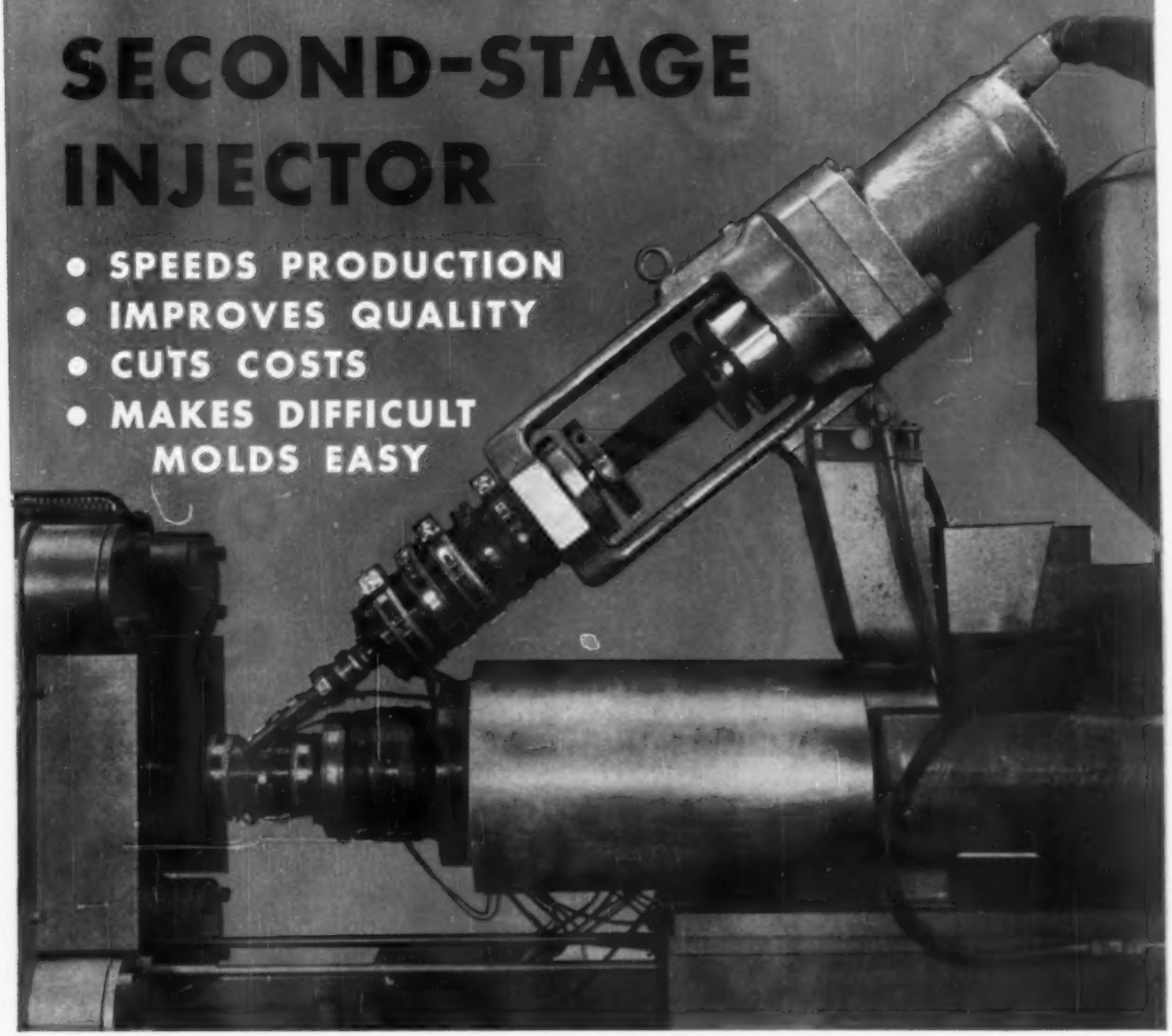

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What's new in processing

A pre-printed method of decorating low-pressure reinforced plastics has been developed by E. F. Twomey Co., Los Angeles. Special papers which are easily impregnated, are inserted in the mold with the glass preform and resin. They can be used in hand lay-ups, sheet molds, matched dies, and may be die-cut to conform to shapes and contours. This eliminates complicated die engraving or hobbing, surface engraving, decals, and nameplates. Art work is designed, and color choices are practically unlimited. Twomey supplies a complete service along this line, which it designates Chromold.

Foam-Flex Corp., New York City, has patented (U.S. No. 2,841,205) a process for producing urethane foam between two layers of material in roll or sheet form on a continuous basis. Materials can be paper foil, plastics, metal, or boards spaced from ⅛-3 inches apart. An interesting side application of this process would be to have one of the confining layers being bondable to urethane, the other not. This would afford a continuous process of coating urethane on a given surface and at a predetermined thickness. The firm has licensed Urethane Systems Engineering, Inc., Willow Grove, Pa. to make its patented machine.

Allied Chemical Corp. has acquired the Snia Viscosa (Milan, Italy) process for the manufacture of caprolactam. The starting raw material is toluene instead of phenol.

Dura-Tech Corp., Boca Raton, Fla., has developed a hot-wire cutter for expanded polystyrene and both rigid and flexible urethane foam which will give a width and thickness cut simultaneously to an accuracy of 0.015. This was proved on a billet measuring 16¾ by 48 by 16½ inches.

Abstracts

"Molding Possibilities of Polypropylene Sheet" by W. Neitzert, Plastverarbeiter, July, 1960, describes the vacuum forming of polypropylene sheet by negative and positive, pre-stretched and unstretched methods. Flow properties are reportedly superior to those of low pressure polyethylene sheeting; shrinkage is much lower; but moldings are more brittle.

"Nylon Parts—Machine or Mold" by E. Graesser, Plastics World, May, 1960, tells which should be used (volume and part design) and how.

"Casting Acrylic Sheets" by J. Beattie, Plastics World, September, 1960, explains the process which calls for critical control of molding and curing temperatures. The economies of casting are pointed out.

Patents

2,942,301 to Central Waxed Paper Co., Chicago, Ill.—Method of Making a Receptacle of Foamed Polystyrene.

2,941,254 to E. I. du Pont de Nemours & Co.—Process of Forming Polyethylene Film and Product.

2,943,967 to Minnesota Mining & Mfg. Co.—Method of Fabricating Reinforced Plastic Male Screw Threads.

2,939,178 to Continental-Diamond Fibre Corp., Newark, Del.—Process for Molding Sintered Polytetrafluoroethylene Articles.

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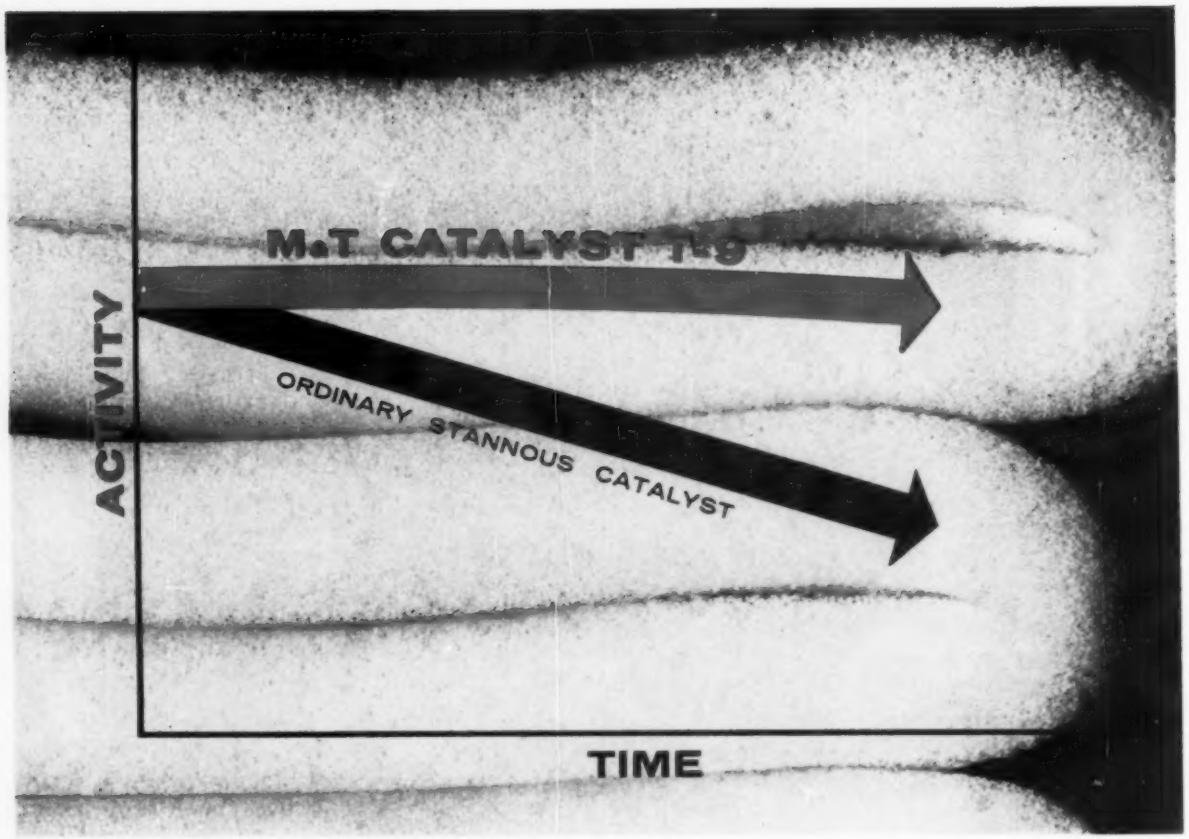

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Editorial: The plastics processor—a "compleat" businessman

Izaac Walton's "The Compleat Angler" pointed out all the qualifications required of the true fisherman. While we don't feel qualified to do the same for the plastics processor, we are convinced he must, indeed, be a complete businessman.

Plastics processing has grown from a small, almost home-workshop type operation to a complex structure involving many thousands of dollars in equipment alone. Yet, it is classed as a small to medium-sized business with attendant risks.

If a big-business firm, let's say a chemical materials manufacturer, makes a sizeable mistake—what happens? The line of materials is withdrawn, some heads "roll" and, possibly, the error shows up in the profits picture. The company, though, is in no immediate danger. If the small businessman makes a major mistake, however, he usually ends up as a Dun & Bradstreet statistic.

What has all of this to do with PLASTICS TECHNOLOGY? Well, it affects our editorial policy. Our original aims—to serve the plastics processor—remain the same. We do not plan to cut the number of technical articles run every month, but to offer you, from time to time, an added article on markets, management, planning, or other topic of current interest.

This month, we are running a survey on "Markets for Flexible Foams." It is our feeling that market studies become more and more vital during periods of increased competition. They are also expensive and almost impossible for the small businessman to conduct—yet, they can be vital.

Suppose you are a molder of thermoset materials. You not only need to know about automatic equipment and fast-cycle compounds, but you must also know what is being done with some of the newer thermoplastics —polypropylene, for instance. It may be, that at some future date, you may be forced to consider a different type of molding technique.

Or—looking at it from another angle—a different price structure for a non-plastic material may permit you to offer a proprietary thermoset item, competitively. To be in a position to do this, you must know quite a bit about both marketing and markets. We hope to assist you in these areas. Please let us know how and if we are succeeding.

The entire staff joins me in wishing you a very happy holiday season, and all the best for the coming year.

Jim Dugan

Editor

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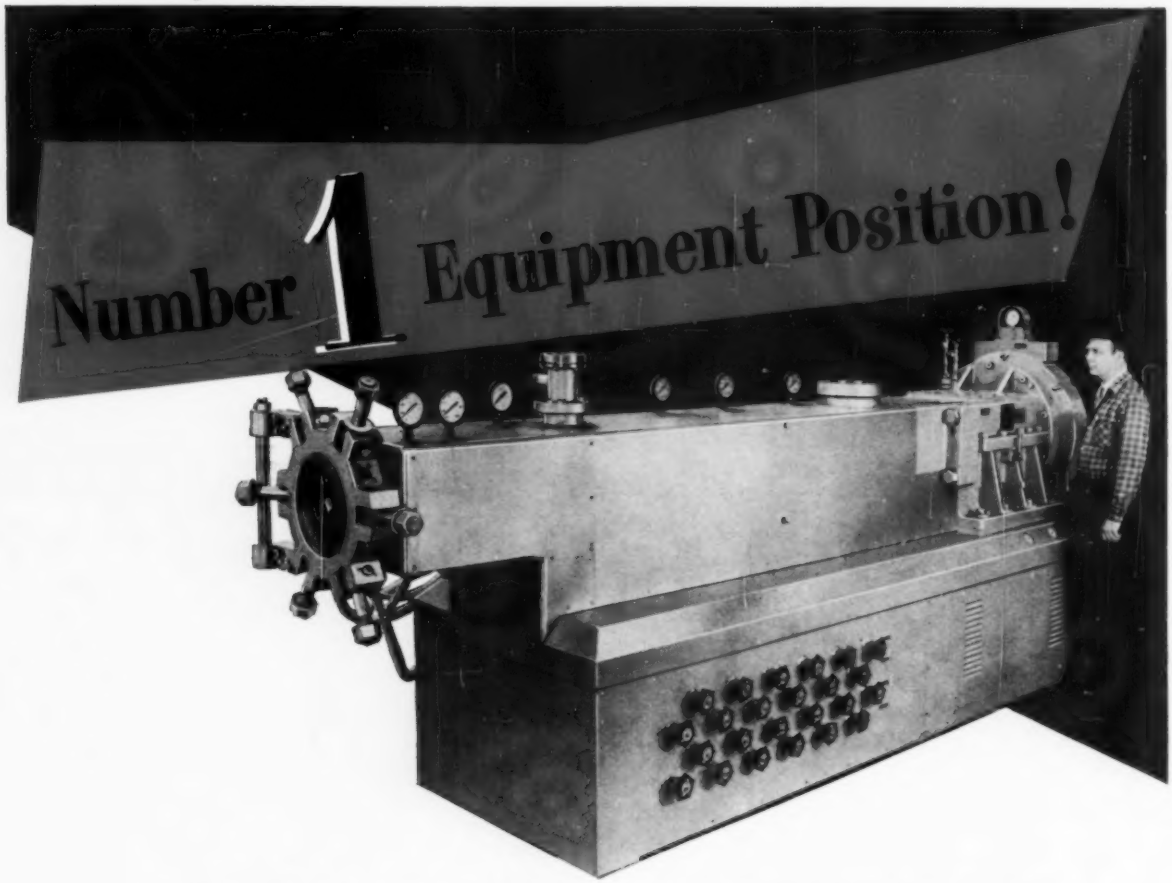

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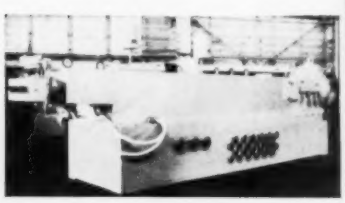

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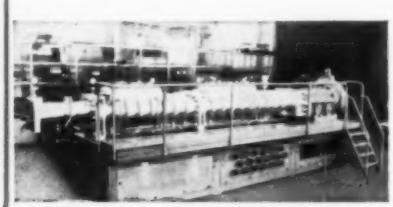

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

The Outlook for 1961

The prediction for the coming year is favorable, but look for more intense competition

Considering the plastics industry and its prospects for the coming year, the outlook for 1961 is quite bright. But there are some unpleasant factors that cloud the crystal ball.

Viewing all the branches of the domestic industry and predictions from various companies in these branches, two conclusions stand out and are worthy of careful consideration: competition will be quite severe in the domestic field; and there will be much more competition from European and Asian countries. Both factors are somewhat interrelated; they both require a greater degree of planning to reduce costs. This will squeeze profits, but with proper attention to materials, molds, and other cost factors for each application, modest sales can be expected. The outlook for 1961 is favorable, all factors considered, but there will be a need for cost-cutting, better product distribution, and better advertising and promotion.

The overall growth of plastics is not over, just slowed down temporarily—the future prospects are still good, but the old blue-sky approach is ended. Plastics companies, whether materials suppliers, equipment manufacturers, or processors, should evaluate their costs to assure efficiency in processes, materials, and labor.

No reversal of this declining trend of earnings is expected until mid-1961 at the earliest, but a company that views its costs objectively and sets about trimming waste factors, while still retaining the material and product design to fit the specific application, for example, will ride out the recession and go on to take better advantage of the economic upswing when it occurs. In other words, don't reduce costs just to meet foreign and domestic competition and cut quality out of your products. The current recession is only that, don't be rushed into any hasty cost-cutting measures. Keep your head, think carefully, and increase your efficiency to reduce unnecessary cost factors. Then when the recession is over, you will be in a good competitive position to take full advantage of the recovery and the rising economy.

Molders, Extruders, Laminators, Etc.

An increase in residential construction is expected in 1961 by Formica Corp., according to its president, R. T. MacAllister. The firm realizes that this increase may only be minor in nature, but is basing its plans on the increase. On the long-term side, Formica continued to invest heavily in a program of research and new product development in the past few months, dictated by its faith in the decades ahead (particularly in the early 1960's). On the short-term side, the firm is already taking steps to strengthen its position as a major supplier in the building-materials field by installing new sheet pressing facilities, increasing its distribution and warehousing organization, expanding its field sales force to handle an increasing diversity of products, and building a multimillion-dollar research and development laboratory. MacAllister disagrees with those who look for a major recession between now and mid-1961. He points out that many minor recessions have been offset in the past by an increasing availability of mortgage funds which have strengthened the building industry, and sees no reasons why the same pattern will not be evident in 1961.

R. B. Jacob, President of Cadillac Plastic & Chemical Co., looks for 1961 to be the best sales year in the firm's history. As a distributor of warehouse shapes in every type of plastic, the firm naturally benefits from the increasing industrial use of plastics in industries which tend to use such shapes and machined parts rather than molded items; such industries include missiles, electronics, and machine tools.

According to its Board Chairman, B. F. Michtom, Ideal Toy Corp. is optimistic that 1961 will be a good year, at least as good as 1960 (this year was probably the best year in sales volume and net sales for Ideal). Improved techniques in advertising and sales lead him to believe that the toy industry and Ideal may very well move upward against an otherwise soft economy. What has been done to stimulate the sale of major ap-

pliances and automobiles can be anticipated to stimulate the sales of toys in 1961.

Speaking on behalf of the five Molded Fiber Glass Companies, R. S. Morrison, President and General Manager, expects the general custom molding market to increase about 12-15%, but does not foresee that custom molding of fiberglass plastic will be spurred by any new field of application. In the fiberglass-reinforced plastic flat sheet field, no big-volume new markets are foreseen, but he expects an increase of about 10% from better sales effort in supplanting other materials. The Tray Company expects to increase its business about 12% over 1960, based on a new polyester resin. The Body Company expects to show an increase of another 25% in 1961 over the 36% increase shown this year. The Boat Company does not expect to do as much business in 1961 in outboard boats as it did in 1959 and this year, nor will there be the equivalent business in boat sizes, but the 1961 dollar volume is expected to be the equal, if not slightly higher, than that of 1960.

Speaking for Plax Corporation, President R. F. Elder is optimistic on the outlook for the plastic bottle industry, with numerous new applications in the offing. A good deal of new capacity will be added, and economic factors are steadily becoming more favorable to the use of plastics in the container field. In the field of biaxially-oriented sheet and film, an advance in machinery for package forming and heat sealing is opening new market opportunities. With prices substantially lower than in early 1960, there is every reason to anticipate significant growth in this field in 1961.

Its injection molding equipment has been running at a heavier schedule than at any time in the history of Precision Plastics Co. Although sales have held up, profits have been squeezed, according to President E. W. Danien. Based on an aggressive cost-cutting system initiated this year, an improved profit picture is foreseen in 1961. As evidence of this optimism, the firm has just completed the installation of blow-molding equipment, and plans to install additional facilities for blow molding, with emphasis on the fabrication of industrial items as opposed to detergent containers. Contrary to any pessimism on the future, Danien foresees the most productive decade for his 19-year old company, as well as for the plastics industry in general.

C. R. Mahaney, Vice President and General Manager of the Panelyte Division, St. Regis Paper Co., foresees a sales volume in 1961 about equal to that of 1960.

Materials

According to J. W. Flynn, Vice President and Director of Marketing for Celanese Polymer Company, 1961 is the beginning of a new growth phase, with the percentage increase much less spectacular than those of the past 15 years. Continued growth will be based on improved materials and better fabricating techniques, and will reflect sound progress in an ever-expanding industry. Celanese expects that plastics business in 1961 will be better than it was in the first half of this year, despite severe competition. Companies with a balanced product line, aggressive marketing, and adequate technical support will enjoy a distinct advantage. Accordingly, Celanese has taken a number of steps to diversify and strengthen its overall plastics operation. Chief among these has been the formation of Celanese Polymer Co. as the fifth autonomous Celanese operating company. It will be a raw materials supplier for resins and molding materials, while Celanese Plastics Co. will continue to manufacture converted polymer products such as sheet and film. Celanese Polymer will open a new and large laboratory devoted exclusively to application and technical service work to continue the expansion of the company's product line, with emphasis on high-performance materials tailored to specific applications.

A spokesman for a major supplier forecasts that 50-million pounds of polypropylene will be produced in 1961.

Because plastics are utilized in a wide variety of industrial and consumer goods, the Dewey & Almy Chemical Division, W. R. Grace & Co., believes that the fortunes of the plastics industry in 1961 will follow the general health of our economy—a gradual improvement over 1960, with no serious drop-off in business.

Hercules Powder Company, via W. C. Brown, General Manager of the firm's Cellulose Products Dept., foresees increasing demand for all three Hercules plastics to continue throughout 1961. Hi-fax high-density polyethylene is expected to enjoy further growth in the liquid detergent container market and increasing sales in the wire-coating field. Flexible plastic pipe is another attractive growth area. Pro-fax polypropylene will continue to pioneer in many fields (film for food packaging, injection-molded luggage with its unique molded-in hinge, outdoor furniture webbing, and auto seat covers). Penton chlorinated polyether has proved especially useful in corrosion-resistant applications involving elevated temperatures, particularly in lined and coated pipe and fittings, valves, pumps, meters, and processing vessels. All in all, the company is optimistic about growth in 1961 for all its plastics.

George Wash, Director of the Plastics Sales Division, Phillips Chemical Co., foresees a big surge in high-density polyethylene and ethylene copolymer sales in 1961. The liquid bleach industry is expected to convert to blow molded high-density plastic containers at the same brisk tempo that the detergent manufacturers did in 1959-1960. Incidentally, the bleach market alone represents a market of 60-million pounds or more for high-density polyethylene. The automobile industry also will be using millions of pounds of high-density products in 1961.

The outlook for asbestos-reinforced plastics in 1961 is most promising, according to J. A. Bettes, Jr., Manager of the Reinforced Plastics Dept., Raybestos-Manhattan, Inc. The trend in industry is toward ever-higher operating temperatures, therefore the need for plastics reinforced with asbestos fabrics, felts, mats, or molding compounds, paced by further advances in missiles and rockets. In the field of fluorocarbons, Bettes sees further expansion of markets based on cost reductions in the basic polymers and new polymers being developed to serve specific applications. These facts assure new and expanded markets for fluorocarbons.

Equipment

Frank W. Egan & Co. looks for 1961 to be at least as good a year as 1960 whose sales were approximately 30% higher than 1959, according to Vice President W. H. Willert. Egan noticed a slight decrease in the number of orders received during the last few months of this year. However, this decrease cut into the firm's backlog of orders rather than new shipments. The demand appears to be for shorter delivery times, and indicates less long-term expansion by customers than in the past. Willert believes that customers are somewhat cautious and buying only what they need to keep present equipment in operation, rather than committing themselves to future expansion. On the brighter side, there has been an increase in requests for quotations and information for budgeting purposes. This is encouraging since it indicates that the companies are planning for the future. Sales of equipment for plant expansion by raw materials suppliers has fallen off substantially. Sales of equipment for extrusion coating, film, plastic pipe, and both general and custom extrusion work is at the same level as one year ago, but there has been a substantial increase in inquiries and orders for laboratory equipment.

A major manufacturer of equipment is not forecasting any sizeable increase in sales of their equipment in 1961 because of a cloudy picture. In fact, it will be satisfied to maintain the sales volume of this year (which was a maximum load on their facilities). In view of the lack of further long-range expansion plans by their major customers and the increasing number of new developments that have been announced, the total picture is confusing since the two factors can counterbalance each other.

HPM is anticipating a leveling-off of plastics machinery sales in 1961, according to T. G. Bishop, Product Market Manager. The company's primary market is expected to be in the automotive market, both captive and custom, and in other industrial fields. A major break-through for plastics in these industries can happen in 1961, influenced by new materials and lower price structures for existing materials. The prime markets for machinery sales in housewares and in toys are reaching the saturation point, so new areas must be found to keep machinery sales up to their present level.

The coming year will bring serious competition in molding equipment from European manufacturers, particularly screw-type injection machines, says A. R. Morse, President of Injection Molders Supply Co. The shrewd American molder should approach the matter of screw-type injection units with caution. Of the approximately 30 different basic designs of screw plasticators now in production in Europe, he should select the one that is most suited to his needs or he will end up soured on the whole principle of screw-type injection molding. It should be noted that European conversion to screw injection would not have occurred so quickly were it not for their lack of adequate electric power, water, and good heating cylinders. Since the differences between screw-type plasticators are more acute than differences between plunger-type machines, two or three years experience is required before a proper comparison between screw-type injection units can be made, so look well before you leap.

Another major manufacturer of molding equipment looks for an increase in its sales of 10% in 1961, with major impetus coming from a trend toward automatic molding, continuous in-line processing of films, and further adoption of blow molding to materials other than polyethylene.

The Waldron-Hartig Division, Midland-Ross Corp., is extremely optimistic for 1961. We expect general business to improve, based on recent advances in extrusion and in-line equipment such as extruder-blow molder combinations, sheeting lines, and complete pelletizing lines, says R. J. Jacobs, Vice President and General Manager. The market for plastics extruders and associated equipment in 1961 will be at least 8% higher than 1960. However, business will not be easy to secure, but will be gained by those companies whose levels of technical competence and services to the industry are above average.

Moldmaking

Better business is predicted in 1961 than in the second half of 1960, but not as good as 1959 or the first half of 1960, according to J. A. Kavanagh, Executive Vice President of Standard Tool Co. Moldmakers are entirely dependent on molders, of course, and feel that competition will be much more severe, based on the American economy and the magnitude and diversification of foreign imports. The moldmaker was the first to feel the impact of foreign competition in mold prices—in many ways, the American molder taught the European moldmaker our methods, and in a sense created his own competition from areas where moldmaking labor costs are negligible compared to ours.

American mold costs have always been a necessary evil of the moldmaking industry and can only be paid for by production and sales of the molded items produced in the mold. Surprisingly enough, the American molder continues in the majority of cases to build molds with as many cavities as possible to be operated in large molding machines; the average domestic molder has 8- and 12-ounce machines and wants to operate them at near capacity. However, there is a definite trend today toward smaller machine sizes (with smaller dies and less cavities) when the product is within the capacity of the smaller molding machine. This smaller size of machine uses cheaper dies with less cavities, but operates more rapidly at a much faster rate of production, sometimes equalling the output from larger machines having more-expensive molds.

In essence, there is no place for a poorly-designed and poorly-built (and cheaper) mold, nor can the molder continue the present method of requesting mold quotations without specifying mold material, construction method, and other applicable factors. New materials have made it necessary to build and design molds with careful attention to gating, cooling, and venting. It is necessary, therefore, to choose the material before ordering and specifying the mold. Hot runner molding is being used more and more extensively. This type of mold tends to offer automation even when operated in older equipment. Auxiliary equipment also offers opportunities for economy in operation. —THE END

Technical aspects of molding acrylics

This first half of a two-part article covers Plexiglas and Implex formulations, their physical characteristics, mold design, and gating systems

J. F. MOORE*

Injection molding of acrylics and modified acrylics generally involves four considerations: basic materials and their characteristics; gate, runner, and mold design requirements; techniques of molding the part; and the test for quality.

Materials

With the advent of newer and more exotic materials such as the polyolefins, polyethylenes, polyamides, polycarbonates, ABS polymers, and our own Implex, one tends to forget the older, stable materials. The acrylics have long been known as the "jewel" of the plastics industry, and it is a description well suited to this family of water clear, glistening materials.

At present, there are three formulations of Plexiglas and four formulations of modified acrylic—Implex. Grades 5 and 6 of the regular acrylics are widely used for injection molding of brush backs, optical lenses, transparent shoe heels, telephone finger wheels and headsets, signs, and lighting fixtures of large area where the stiffer flow of Grade 8 materials present mold filling problems.

Grade 8 is the best outdoor weather performer, has the best solvent resistance, and is the standard material in use today for automobile tail-light lenses, speedometer clusters, and decorated parts used by industry.

One grade of Implex is used widely in opaque women's shoe heels, housings, outboard motor shrouds and, generally, where toughness and good outdoor weathering are required. Implex is not nearly as good outdoors as Plexiglas, but is equal to and better than any other high-impact modified material in production at this time.

* Technical Sales Rep., Rohm & Haas Co., Phil., Pa.

Figure 1 shows a flow chart for the manufacture of Plexiglas molding powder. You will note at the top of the chart that the materials involved are common materials available from petroleum, natural gas, air, and water. Two basic processes are carried out. The first involves making methyl methacrylate using air, ammonia, and natural gas to obtain hydrogen cyanide. Secondly, propylene derived from petroleum is reacted with water under the proper conditions to form acetone. You probably recognize this as a nail polish remover and injection mold degreaser. Hydrogen cyanide and acetone react to form a compound known as acetone cyanhydrin which, when properly treated with wood alcohol, gives methyl methacrylate, the basic material in Plexiglas.

These water clear liquids polymerize in the presence

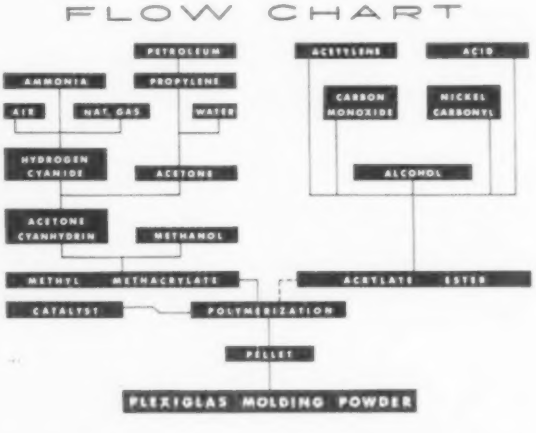

Fig. 1. Flow chart for the manufacture of Plexiglas molding powder.

of a catalyst, converting from liquid to a solid. This solid is then pelleted and becomes Plexiglas molding powder.

The pellet size ⅛- by ⅛- by ⅛-inch is designed to fall or feed evenly down the sloped sides of the feed hopper on the molding machine. This angle is so designed that materials will fall evenly and not from the center, leaving the pellets on the outside clinging to the sidewalls of the hopper.

Pellet size is also based on the heat transfer of the material involved, so that softening of the pellet will not be too uneven. If the pellets are too small, air entrapment can be a serious problem. When air is carried into the cylinder it becomes a major cause of splash. Granules that are too small melt quickly on the surface and are compacted in such a fashion as to trap air within the mass. This air will not be released until the plastified material is released into the mold. Very small pellets are good for dry coloring because of their large surface to volume ratio. Later, we will show how pellet size, granules, and regrind affect the quality of the molded part.

Mold Design

The cost of an injection mold largely decides which molder will get the business. It is also recognized that different molders can bid on the same design, build four different type molds of different metals, gate the parts by different methods, and produce parts which will fill the bill insofar as the end-user is concerned. There may be a 25% difference in the costs between the highest and lowest bidder, depending on the method used to produce the cavities. A hobbed cavity will be more expensive than a beryllium-copper cavity, but less expensive than an engraved steel cavity.

How do we gate the part? How can we run a 24-ounce shot in a 12-ounce machine, in your material, at fast cycles? Books describe the flow of materials and their physical properties, but few if any give information on the gating procedures.

Gating is usually left to the molder's engineering staff. The engineers rarely call in the molding foreman for discussion, although we feel that they should in all cases. The general procedure is that the molding foreman inherits the mold late in the afternoon, one week or more after delivery date—three days after a salesman's promise to the end-user that dimensional samples were mailed yesterday!

It is not unusual that the mold and customer arrive at the same time. After a few shots, run manually, a tool maker is hurriedly called in to grind away at the gates while the mold is set. When the gates are opened to the degree determined by the group of "experts" standing around, the mold is again started up. If filled parts are obtained, the mold is declared in production.

Generally, parts produced by this procedure have poor physical properties and are poorly degated with a fractured area at the gate. This is due to high molding stresses. Parts fail and the end-user calls in the molder, who calls in the material supplier, who will be told "The material you supplied was no good, or else the parts would not have failed." After some discussion, a course of action is decided upon, the mold is

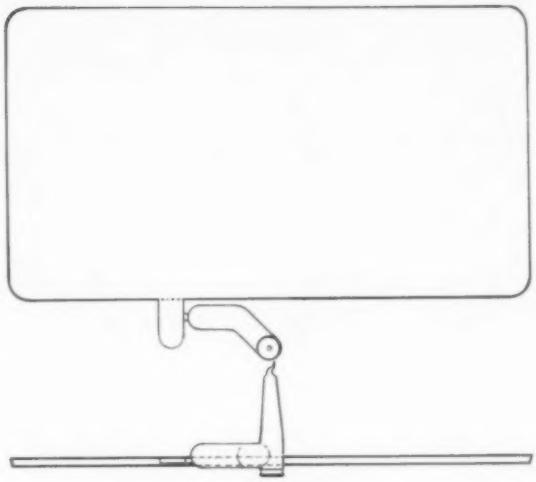

Fig. 2. Typical single-cavity shield.

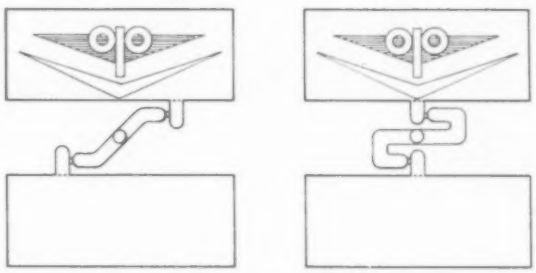

Fig. 3. Two-cavity mold for tab-gated parts.

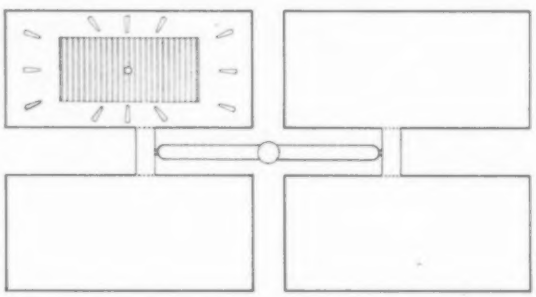

Fig. 4. Four-cavity mold with bridge tab gates.

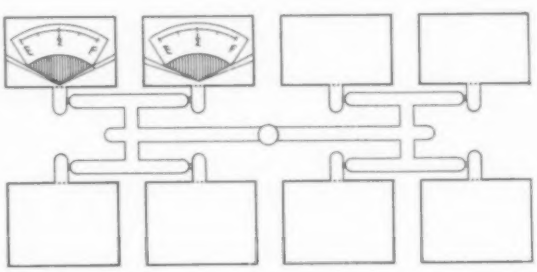

Fig. 5. Eight-cavity tab-gated mold.

regated or repaired, and new parts molded. Good parts are produced, and the problem is forgotten since most molders do not take the trouble to keep progressive records of their trial runs.

Rather than discuss theory on gating and molding, I felt it might be more interesting to discuss gating procedures which work well with Plexiglas and Implex, and why.

Acrylics, even in their softest form (Grade 5), are relatively viscous. They do not require external lubrication to reduce cylinder friction or for mold release. A basic requirement for molding them is to deliver the material sufficiently hot and fluid to the mold cavity. Careful control of the runner and gating system is necessary to obtain maximum luster and physical properties. Heat loss is minimized through the sprue and runner system. The following sketches will demonstrate some of the gating procedures and methods used (on production molds) to produce satisfactory parts.

Figure 2 shows a typical single cavity shield. Usually, to gate this part, a fan gate an inch or more wide, or a three plate mold is used, with runners across the top of the third plate—through a sprue bushing, or well in the side of the part. The latter involves a higher mold cost, plus loss of material in long sprues and runners. Experience has shown that conventional gating into a part of this type produces high stress at the gate area which is almost impossible to relieve by annealing.

With tab gating, a small gate is cut between the ball end of the runner and the tab which is connected to the cavity wall. The small gate builds up frictional heat by restriction and causes the hot plastic to impinge against the blank wall of the tab. The plastic front is smoothed out and fills the cavity with a flat even flow of plastified material.

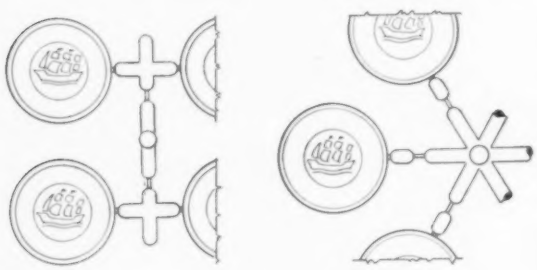

Fig. 6. Use of runner restrictions.

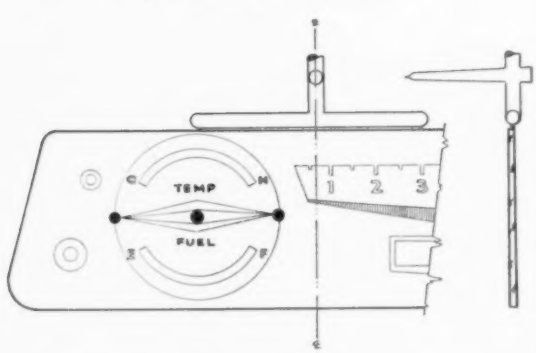

Fig. 7. Flash gating for flat dials.

Figures 3, 4, and 5 show typical two-cavity, four-cavity, and eight-cavity mold layouts for smaller, tab gated parts. Note that we always strive to obtain balanced fill. In each case, the gate entrance to the cavity is the same distance from the sprue as every other gate. It should be pointed out here that we have never seen a balanced six-cavity mold unless it was layed out in a circle.

Minimum tab size should be ¼-inch wide by 75% the thickness of the cavity in cross section. Gate size should be the thickness of the tab by twice this measurement. In other words, if the tab is 0.08-inch thick, the gate should be 0.08-inch by 0.16-inch. It is equally important that the land area not exceed 0.06-inch in length.

Tabs can be left on the molded part until it is completely decorated. The operator merely clips or breaks the gate and disposes of the runners and sprues. These sprues and runners provide cleaner regrind since they have not been run through a saw or clippers which might contain grease or dirt. In the decorating operation, the tabs act as a handle; therefore, it is not necessary for anyone to touch the face of the molded part. After decoration, the tabs are easily removed with a thin slitting saw or hot knife degater.

Only fairly flat, thin parts lend themselves to tab gating. Deep drawn, or box shape parts such as tail light lenses, marker light lenses, horn buttons, and parts of this design do not lend themselves to tab gating. Here, the normal flattening effect of the tab gate causes peripheral flow which further aggravates the fill problems and air trap generally experienced when this type part is side gated. A conventional gate cut into the parting line will suffice to fill such parts.

A restriction, placed in the runner (Fig. 6) about ⅔ the distance from the sprue end to the gate will accomplish two things: It will reheat the plastic by narrowing or restricting flow just prior to the gate entrance (this counteracts the cooling of the material as it flows through the runner path), and it provides a rapid pressure drop along with the heat rise. This gives the operator better control over the injection pressure without overpacking the cavity. The restriction should be 25% of the runner diameter with a land length of ¼-inch. It should, in all cases, be smaller than the gate.

Another type of gating used for flat dials is called flash gating (Fig. 7). Initial work was done on this type gating as early as 1951, when one of the automobile companies designed a 3- by 32-inch instrument cluster. Production ran for two years using conventional gating with only fair success. When production slacked off on one of the two molds, the flash gate was tried with good success. Little was done with this type gate until 1956 when the companies again designed long, flat, thin instrument clusters. Requirements for this type part were flatness, lack of warp (if the part is warped severely the wiper will throw the part out and/or tear the wiper cloth), minimum of tails on engraved letters, and a minimum of welds off holes.

Tab gating was used widely on this type part, but has been replaced by flash gating, primarily for its ability to mold flatter parts.

Note that flash gates can be used only when the piece has at least one uninterrupted straight edge. Flash gates are not economical with curved edge or circular dials. The flow into the cavity is not uniform and it is difficult to mill the gate and degate the part. Where curved edges occur, it is better to use a tab gate.

The flash gate should be located on a plane with the top or bottom surface of the cavity so that the molten material entering the cavity will immediately contact one of the mold surfaces and cause the incoming material to swell as a smooth envelope rather than to jet. The linear flow provided by this gate holds the melt shearing in the cavity to a minimum, thus resulting in higher, effective cavity pressure. The gate may actually be as thin as 0.010-inch without a severe loss in efficiency. A combination of good melt blending, high cavity pressures, and rapid freeze off results in cycle economy and better quality parts where this type gate is applicable.

In flash gating, the gate length should not exceed 25% the cavity length. A longer gate will produce a three-way fill pattern. That is, flow will break out at each end of the gate and possibly at the center area adjacent to the supply runner. This fill pattern creates heavy welds and weak parts. Gate thickness should be 25% the thickness of the cross section (a part 0.100-inch thick would require a gate only 0.025-inch thick). Land length should never exceed 0.025-inch. This is the most important part of the gating design. A longer land length chills the material entering the cavity and causes a too rapid pressure drop.

Where part design permits, probably the most efficient method of gating these materials is with the so called "center shot" gate (Fig. 8). This is generally thought of as a small diameter gate cut between the secondary sprue and cavity wall. Certain economies result from this procedure even though the mold cost is higher, since a three-plate mold is necessary. The three formulations of Plexiglas and four formulations of Implex mold very well in this type gating system.

When designing for Plexiglas, one modification is necessary to obtain improved appearance. Due to the rigidity of Plexiglas, it is necessary to separate the gate entrance from the cavity wall. This is done by milling a secondary gate well, no larger than 0.150-inch diameter with a maximum height of 0.125-inch in the cavity half of the mold. The gate is attached to this well. Gate shearing takes place away from the surface of the molded part. This prevents splintering of the gate or tearing a hole in the molded part. The gate well is preferably milled off, although it can be clipped. Normally, this is milled to leave a 0.010-inch projection above the surface.

This type gating is used almost universally in the molding of tail light lenses. It provides good reflex, eliminates poor fill due to irregular contour, and removes the high stress area from the parting line which is the normal mounting area on the automobile. The following specifications should be considered when gating parts using the "center shot system":

SPRUE BUSHING—11/32-inch diameter if a conventional mold, 7/32-inch if a sprueless mold—nozzle size to match.

MAIN RUNNER—0.375 full round.

SECONDARY SPRUE—0.375-inch diameter to match main runner, tapered to 0.250-inch diameter at gate end—well polished. Recent work on this type mold indicates that a flat at the base of the secondary sprue (instead of a radius) will do a better job.

GATE—the gate should not exceed 0.975-inch diameter with a land length of 0.060-inch. If the gate is too large, a resistance to shearing will take place on the mold opening sequence. This tends to pull the runner and sprue system tightly into the sprue well causing difficulty in removing the runner system from the floating plate.

GATE PULLER—some method of shearing the gate must be built into the mold. This can be a smooth, tapered hole into the runner adjacent to the secondary sprue. Better, it can be a slug created by drilling an angular hole into the stationary plate at the end of the runner. This does a good shear job and does not interfere with the flow of material through the runner as does a tapered, drilled hole.

The so called sprueless molds do their best job on this type mold. They eliminate the old bugaboo of sprue sticking and put the injection pressure right where it belongs; that is, on the runner.

Implex, being a more flexible material than Plexi-

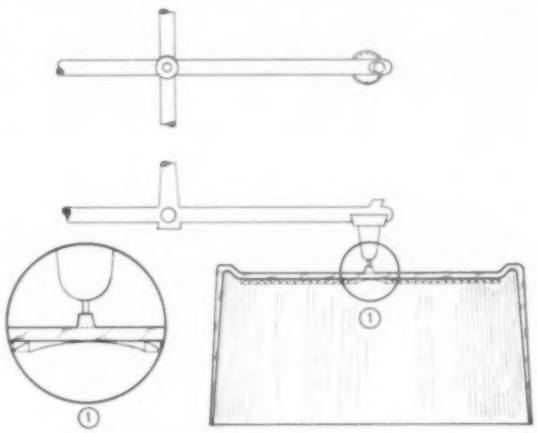

Fig. 8. Center gating. A 4-cavity, 3-plate mold.

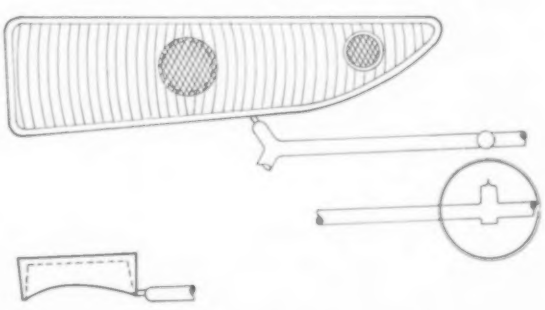

Fig. 9. Typical sprueless mold for acrylics.

glas, can be molded in the center shot molds by getting directly into the cavity without the secondary well (similar to other high impact materials) without gate splintering. All other factors listed above will remain the same except gate size, which can be reduced to a 0.035-inch diameter. Figure 9 shows a typical acrylic sprueless mold. We mentioned this as being helpful when molding. Initial work was done on large area molds and the first attempt was to eliminate the sprue bushing completely, bringing a heated, flat-headed nozzle directly into the main runner.

This did an excellent job of molding but created a problem in the molding plant because each flat head nozzle became a special item and thus could not be used for all molds. A modification of the sprue bushing resulted in one that was ½-inch high with the standard ¾-inch radius. This is used widely today. It is felt this simple modification offers four benefits: reduces the amount of material used in the shot; eliminates sprue sticking; increases the efficiency of mold filling by reducing the cooling effect of material flowing through a long sprue bushing; and offers cycle economies. Note that the sprue bushing can be reduced one to two sizes. Very often the total cycle is based on the time required to set up the base of the sprue bushing. It is still desirable to include the normal ⅛-inch radius at the base of the sprue bushing.

A very common mistake made when designing molds for Plexiglas and Implex is to shut off the fill system at both ends. By this, we mean the mold designer will provide an undersize sprue bushing and gate, then use a large runner system.

More important than gate or runner size is the use of the proper size sprue bushing. Here, volume filling begins, pressure starts dropping, and material cools. When designing fill systems for acrylics we recommend the following:

Sprue bushing—11/32-inch diameter if standard, 7/32-inch if sprueless;

Runners—0.375-inch full round over 10 inches in length, 0.312-inch full round under 10 inches in length (runners need not be highly polished, but should be ground smooth and at least match each other in both halves of the mold. To insure sufficient back pressure when filling the mold, we suggest secondary runners be reduced to the next diameter); and

Land length—should not exceed 0.060-inch. Quite often the shortening or lengthening of land length will do more to balance a multiple cavity mold than opening gates.

The shape of the gate has a great deal to do with the efficiency of the knockout and subsequent stressing of the part during knockout time. Plexiglas molds best with rectangular gates, with 15° draft angle per side to give easy release. It is less expensive to run straight milling cutters through the gate area of the mold, thus giving a gate with zero degree draft. The usual result is a gate that fractures into the molded part making the part useless. Reducing the injection pressure might stop the gate sticking but will result in some other defect.

Minimum draft angles for these materials are in the range of ½°, but we prefer 1° if possible. Compared to other thermoplastics, the acrylics have good mold release built into them.

To produce a good part requires adequate venting of the cavities. Hot plastic must force the air out of the cavity in order to replace it. If the mold base seals tightly, more pressure and heat will be required. The result, otherwise, is either a flashed cavity (which is expensive to repair) or an oversized part that the customer will not buy. Since the acrylics are more viscous, vents can be cut to a maximum of 0.003-inch deep and preferably 0.375-inch wide, and in a sunburst pattern around the cavity.

Molds should be cored for heating and cooling. This is probably the least engineered part of the mold. Usual procedure is to lay out the mold; place the ejector pins, pillar blocks, and other incidental items in the smallest mold base possible; then try to squeeze in a few water lines here and there. Most of the time the holes are drilled undersize because there is not enough room for the correct size channel. For best results, the heat exchange medium, (usually water) should be circulated as close as possible to the cavity and still give temperature uniformity. This allows the greatest amount of control possible. The material from which cavities are made is often ignored when water lines are planned. Of the common materials used for molds, beryllium copper has the highest coefficient of heat transfer while brass, soft and hard steel, and finally stainless steel are progressively poorer in the order listed.

Few people realize that chemically hardened steel has only half the heat transfer of soft steel. Actually, we are not too concerned with heat transfer speeds, since it is much faster than the plastics material being formed in the cavities. Size and location of water lines should be carefully considered along with the choice of mold material. For instance, water lines that are too close to the surface of a steel cavity can result in hot and cold spots due to low co-efficient of heat transfer. The same coring in a beryllium copper mold would not be so critical. Fewer channels in beryllium copper, if properly placed, are needed to obtain the same results as with a steel mold.

Zone heating of large area molds has been used successfully to obtain even flow of the plastic over the entire cavity area. When planning a mold of this type, the water lines are drilled vertically, instead of in the normal horizontal position. The inboard, or sprue area is maintained at about 140° F., while the outboard, or ends of the mold are maintained at 180° F. This procedure allows mold filling to take place with reduced injection pressure, thus preventing flash at the center of the mold while trying to fill the ends.

We feel ⅜-inch diameter water lines are too small for efficient heating or cooling of the mold. We prefer ½-inch water lines (a 11/16-inch hole tapped for ½-inch pipe).

Another phase of mold building and design that is under-engineered, usually for cost reasons, is the number and location of knock-out pins. We feel they should be located every 1½-inches around the parting line for easy and positive ejection of the molded part. They should be ground to the level of the parting

line. Long knockout pins will tear the hot material as it flows through the cavity, causing defects such as splash, blisters, and bubbles. They also create a high notch sensitivity due to the sharp corners left in the area of the knockout pins. Diameter of the pin is, of course, based on the wall thickness of the molded part.

Also important is shrinkage. This is the most discussed and guessed-at phase of mold design. The published mold shrinkage range for acrylics is 0.002-0.008-inch. Some of the ethylene and nylon shrinkage factors are in the range of 0.025-0.035-inch. Shrinkage factors are designed into the mold and not arbitrarily fixed by the mold builder. These figures are based either on past experience or published figures by the materials manufacturer.

Several factors affect shrinkage of molded parts. Mold shrinkage is based on cold mold to cold part measurement, and this figure cannot be obtained correctly unless both parts have reached room temperature. This means that molded parts should not be measured until several hours after molding.

Dimensional shrinkage is based on: mold shrinkage designed into the mold by part shape; thermal expansion of all areas of the mold cavity metal; dimensional stability of various lots of molding material; gate size and location; mold temperature and its constancy, hour to hour; cylinder temperature in relation to mold temperature; length of plunger dwell or injection time; number of gates on the molded part; and location of gate in relation to the shape and length of the part.

We believe the above nine items could be expanded into a technical paper on their own merit. Recent work done by us in the field on a high production part indicated that parts molded by the tab gate system do not shrink the expected and usually figured 0.004-inch. Average shrinkage was in the range of 0.002-inch (0.004-inch is a figure used widely on acrylic parts).

A careful check of many tab gated molds produced this same low shrinkage value. The reason for this is probably the rapid, efficient filling of the mold with uniformly heated plastic. The plastic flow is smoothed out and fills the mold in a radial pattern. A further study was made of a conventionally gated tail light lens—a simple box shaped part 4- by 8- by 1-inch deep; the gate being in the center of the long dimension at the parting line.

When this part did not fit the die casting, both were measured and it was found that the molded part had taken two different shrinkage factors. The area parallel with the flow (short dimension) had taken the expected and planned for 0.004-inch. The area perpendicular to the flow (long dimension) took only 0.002-inch shrinkage. Naturally, the holes did not line up nor did it fit the die casting. This is necessary since the part must be water sealed. Mold changes were discussed and, in fact ordered. Before this took place we tried every conceivable molding technique available, but could change the shrinkage only about 0.002-inch along the entire length.

Leaving the center gate intact, we added another gate of the same dimension, halfway between the present center gate and the end of the cavity. Molding the part under a wide variety of conditions resulted in a shrinkage factor of 0.004-inch in both directions. The part then fit the die casting. Out of curiosity, we then blocked off the center gate and molded 250 parts with the end gate only. The parts also had a shrinkage factor of 0.004-inch and also fit the die casting. This part and others of similar design are still molding satisfactory parts using only the end gate. It would appear then that gate location very definitely affects mold shrinkage. It certainly is less expensive to regate a mold than to recut it to change dimensional factors. On a pure "guesstimate" basis, faced with the same problem again, we would recommend that two shrinkage factors be considered. We would recommend that the long dimension be figured at 0.002-inch and the width be figured at 0.004-inch. This would apply to molds where only a center conventional gate is applicable, and to parts where the long dimension is at least twice the short dimension.

Sinks at the juncture of ribs, bosses, or flanges can be controlled with good appearance if the rib area is designed to a thickness of only 75% of the overlay. This means that if the overlay or top of the molded part is 0.100-inch thick, the ribs should not be more than 0.075-inch thick or wide. This is also true of "bosses." If necessary, they should be cored out to meet the above ratios.

Mold polish certainly affects the problems of the molder attempting to produce a good quality part. A box-shaped part with a fairly deep sidewall can be polished peripherally in one third the time required to draw polish the sidewall in the line of ejection. With the pressures required to mold most of the present day materials, there is a 5,000 psi. pressure on the sidewall of the part when the mold is full. This pressure forces the plastic into the polished peripheral lines. The result is sticking and fractured parts. Simply draw polishing the sidewall will eliminate the tendency to stick, since packing and ejection are in the line of flow rather than perpendicular to it.

Mold polishing around letter areas of flat speedometer and other dials is always a source of discussion between the molder and customer. If the areas adjacent to the letters are not as smoothly polished as the balance of the mold surface, the lettering will not edge light smoothly. A heavy haze will surround each character. The first rule of edgelighting Plexiglas states that light will escape wherever there is a break in the surface. Poor polishing produces a similar effect. A visit to a darkened area where the edge-lighted dial can be observed in its use position will tell many things about the need for better mold surface polishing.

Mold Design for Implex

Practically all of the comments noted above also apply to Implex in all four formulations. However, certain liberties can be taken with Implex gating, since it is a more flexible material than Plexiglas. These liberties are listed below and should be used as a guide when designing gating and runners.

Implex lends itself to submarine or tunnel gating either by the accepted method of gating directly into the second surface of the molded part, or by a slightly different technique, which for want of a better name, is called "plug gating." Implex, like all other modified

materials exhibits gate smear and surface blush tendencies which must be overcome in the gating process assisted somewhat by the molding technique. For this reason, the gates, except under drastic circumstances, should never be attached to the first surface sidewall of the part, nor at the first surface parting line of the molded part.

Figure 10 shows a type of submarine gated part, very much like an inverted three-plate layout. The gate is directed into the body of the part, on the second surface. As the mold is opened, the runners are held tightly between the core and moving plates until the gates are sheared. The finished part is ejected with no gate smear or surface blush. Specifications for this type gate are: sprue bushing— 11/32-inch in diameter, nozzle to match; runners—5/11-inch (0.312-inch) trapezoidal-

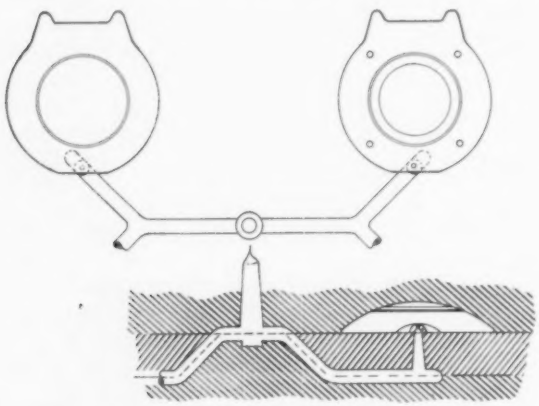

Fig. 10. Submarine gate to the second surface (Implex).

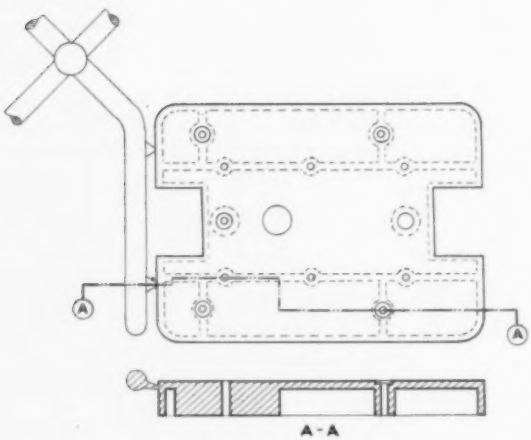

Fig. 11. Implex part, submarine-gated on the first surface.

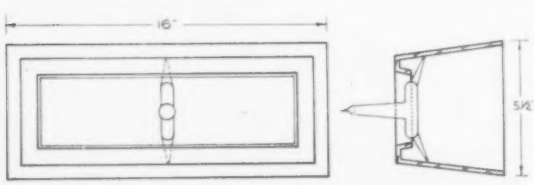

Fig. 12. Typical two-place submarine gate.

secondary pillar is 0.250-inch in diameter at runner parting line, tapered to 0.125-inch spherical radius at gate parting line; and gate,—0.040-inch diameter submarine gate with a maximum land length of 0.060-inch.

Figure 11 shows an Implex part, gated submarine fashion on the first surface in two pieces. Minor gate smears are present on the molded part, but it produces a better part than gating by conventional methods. Again, a finished part not requiring degating operations is produced when the mold is opened. Specifications for this type gate are: sprue bushing—11/32-inch diameter (0.343-inch)—nozzle to match; and runners —5/16-inch full round (0.312-inch)—secondary runner or gate wells are 0.258-inch in diameter at runner end, tapered to a 0.045-inch gate into the body of the molded part. The part is gated in two places due to the large number of molded-in holes and strength requirements. Another factor in placing two gates was to take advantage of the two heavy ribs as runners in filling the part. Note that the gate is purposely adjacent to the ribs.

Figure 12 shows a typical two-place submarine gate, well suited to molding Implex box-shaped parts of a fairly long dimension. Note again, that a finished part is produced as the mold opens and the gates shear. There is no further finishing of the part. Gating specifications for parts of this design are the same as those for Figure 11.

Figure 13 shows a typical transistor radio case gated by the "plug" gate method, which is a submarine gate impinging against the base of a pillar or plug formed by drilling a tapered hole through the steel mold core. This method of gating has, by far, produced the best surface finish obtained when molding Implex.

The theory behind development of this gate system is that, whenever possible, the gate should be as far removed from the body of the part and parting line as physical dimensions will allow. In degating, the plug can be clipped easily or milled to the cavity overlay. A knockout pin should be placed under the plug to facilitate ejection and gate shearing. In some molded parts, it is possible to develop the plug by shortening a knockout pin. Specifications for this type gating are: sprue bushing—11/32-inch diameter (0.343-inch)-nozzle to match; runners—if under 3 inches in length, 0.250-inch full round, if over 3 inches in length, 0.312-inch full round; plug or pillar—0.250-inch diameter at contact point with the cavity tapered to 0.125-inch diameter at gate junction; and gate—0.045-inch standard submarine gate tapered from the spherical end end of the runner to plug.

A variation of the plug gate is shown in Figure 14, where a flat vertical tab is attached to the bottom half of the molded case in place of the regular plug. The existing "boss" was merely extended below the parting line and the submarine gate impinged against the flat vertical tab. The tab is then clipped off at the parting line. The flat tab was used on this mold because of this problem of clipping or milling a plug from a curved, fairly deep profile. It was also tried as an experiment, and it worked very well. As you note, the

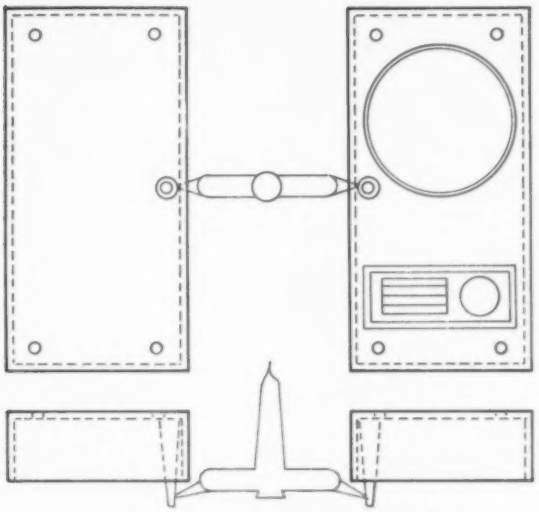

Fig. 13. Transistor radio case, plug-gated.

recommended plug-type gate is used on the other half of the mold. Both systems work very well. The plug offers the advantage of leaving no surface blemish on the parting line or viewing surface.

If none of the gating systems noted above is feasible due to part design, and a conventional parting line gate must be designed into the mold, we suggest a runner block to be placed in the main runner. This is similar to that used on Plexiglas except the location of the runner block is somewhat changed. The restriction should be so placed that a sphere remains adiacent to the gate area. Figure 15 shows a runner block used in Implex molds. As you recall, the runner block used on Plexiglas was placed 2/3 the distance from the sprue bushing to gate area. With Implex, the runner block should be placed about 95% of the distance from sprue bushing to gate area. Implex surface glass suffers badly if the melt temperature is too low; therefore, reheating the plastic must take place closer to the cavity.

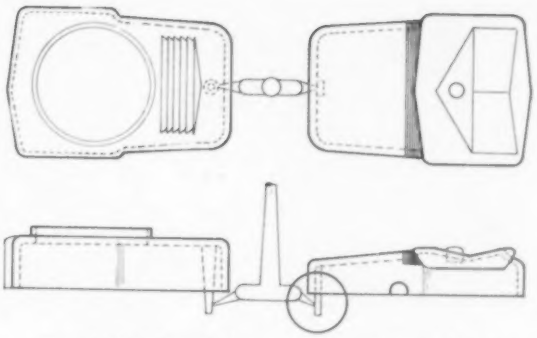

Fig. 14. Variation of plug gate with flat, vertical tab.

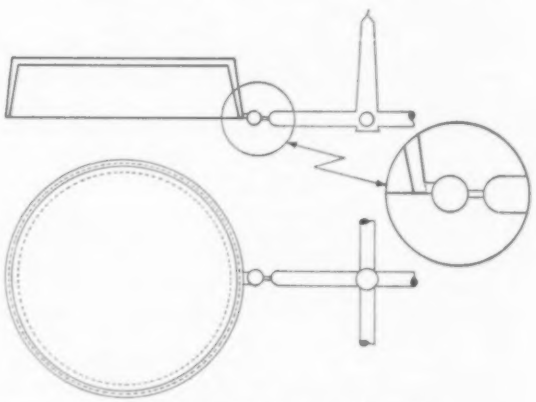

Fig. 15. Runner block for Implex molds.

Runner blocks on Implex should be narrowed down to 10-15% of the runner diameter as compared to the larger requirement on Plexiglas. The land length of the runner block for Implex should not exceed 0.060-inch.

Implex can be stripped from a mold having an undercut, provided the material is not strained beyond its maximum elongation. This elongation is different in the various Implex formulations.

—The End

Urethanes aid failing hearts

As the span of man's life has become lengthened during the past century, it has been beset by medical problems peculiar to long-lived peoples. One of these is heart failure which, although it occurs in other cultures, seems to be most prominent in highly industrial civilizations. As a result, scientists have been engaging in detailed research and experimentation on both prevention and cure of heart trouble.

Unfortunately parts of the heart sometimes wear out, in some cases because of age and in others because of disease. One of the objects of heart research has been the development of replacement parts for those which can no longer do their jobs. Progress which has been made in replacing defective hearts and heart parts with urethane substitutes was outlined at a Conference on Prosthetic Valves for Cardiac Surgery this fall.

Working with Cleveland Clinic Research Laboratories, Goodyear Tire & Rubber Co. and B. F. Goodrich Chemical Co., both major producers of urethanes, have been experimenting with the use of urethanes in heart surgery. Emphasis at Goodyear has been on developing a low-cost technique for fashioning heart valves and the molds in which to make them. Among the requirements which a heart substitute must meet are long fatigue life, compatibility with human tissue, chemical resistance to blood and other body fluids, resistance to the blood's tendency to clot, and ease of manufacture. Goodyear feels that a cast, cured urethane may well be able to fulfill all these requirements.

At the Cleveland Clinic, heart valves made of Estane 5700 X 101 polyurethane, a product of Goodrich, were implanted in the tissues of animals in a series of experiments lasting up to 15 weeks. In some instances, film only three mils thick served satisfactorily.

—The End

Markets for flexible foams

P. B. NORTMAN*

Only a youngster in the plastics field, polyurethane foam has moved ahead dramatically. The outlook is for still higher sales in an expanding market, and the development of new ones. Like any new product, urethane foam presents its share of problems while posing new ones in marketing.

Developed shortly before the urethanes, vinyl foams have certain similar characteristics. Higher price prevents their enjoying the same sales success. A relatively old-timer is foamed rubber latex, which still leads the field volume-wise despite its decline in the past five years. Whether this decline has already hit bottom and can be expected to stabilize at its present level, or whether it will continue to yield ground to urethane and vinyl—or, whether it will recoup its losses in an expanding market are open questions.

In general, half as much urethane as latex or vinyl foams (in pounds) is needed to produce a cubic foot of finished product. Thus, in terms of cubic feet used, urethane consumption is higher than usage of latex and vinyl foams.

Urethane foam has become a major competitor to foamed latex in two major markets—furniture and automobiles. In bedding, it is just beginning to make a dent in latex sales domination, but it should be pointed out that latex has captured but 10% of this market. In the less penetrated fields of packaging, clothing, rug underlays, insulation, consumer products, and the like—both urethane and latex carve out their own markets rather than compete.

Many varieties of cellular plastics (foams) exist, logically divided into flexible, semi-rigid, and rigid types. The field covers a large number of foam products, formulated and designed to perform both general and specific functions. Main competitors in the flexible field are foamed rubber latex, urethane, and vinyl. Among the rigid, semi-rigid, and special-purpose flexible foams are cellulose acetate, low-density polyethylene, polystyrene, phenolic, silicon, and epoxy. This article is concerned solely with flexible foams, specifically the urethanes.

Producers of each type are making determined efforts to push their product, not only at each other's expense, but also in the creation of new markets and products. Ease of fabrication, quality of performance, interchangeability with other materials, and price structure will largely determine acceptance.

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Development

When polyurethanes were first discovered in the thirties, foamed latex was already in commercial production. They were discovered almost simultaneously by I. G. Farben in Germany and by Dr. W. Carothers, a Du Pont chemist in the U. S. The current type product emerged in 1937, when long-chain polymers from glycols and diisocyanates were again uncovered simultaneously by I. G. Farben, and by Bell and Lockheed Aircraft companies in this country. World War II ended our research, but Germany persisted in hopes of developing a rubber substitute. As a consequence, German and other European production and use is much more advanced. After the war, independent research and use of German "know how" spurred renewed activity in this country.

Newest development is the "one-shot" foam process which eliminates prepolymer mixing. Depending on equipment used, savings can approximate 5¢/lb. Foams made with the new dimer acids and sorbitol give better texture, and the use of fluorinated hydrocarbons reduces foam density. New molding techniques, too, eliminate waste and give a better product at lower cost. Most significant, though, was the commercial development of polyether-based urethane foams in 1957. Now, almost 90% of the urethane foam industry is based on polyethers, which offer lower costs, better resiliency, wear resistance, and better insulating characteristics.

The most serious technical problem to be solved is that of controlling the many variables of a urethane foam reaction taking place in a closed mold. Most foam rubber is made in closed molds, and successful application of the molded method would cut the costs of urethane foam. At present the bulk of urethane foam is made in continuous buns and sold as slabs. Even in the open-mold bun process, there is still a lack of consistency in the final urethane product. No industry-wide standards have been established and, at times, buyers do not obtain the product as promised. This, of course, hurts sales. In contrast, the latex foam people have set up product standardization.

Production methods, types of equipment, and even the most economical raw materials have not been set for the urethane foam manufacturers. The chemistry and application of isocyanate foams is still in the process of rapid improvement, but eventually the researcher should be able to turn out a limitless variety of new products, each with its own set of physical and chemical properties.

Capacity is well ahead of sales at present, based on the various companies' whopping market projections. The four basic producers of isocyanates (Du Pont, Mobay, Nopco and Allied Chemical) have capacity of about 65-million pounds. On the polyol side, the major producers (Union Carbide, Dow Chemical, Wyandotte, Atlas Powder, and Jefferson Chemical) have more than enough polyether capacity to meet immediate future needs. Capacity is flexible because the same production equipment is used for different products. In the production of urethane foam, about 30% of tolylene diisocyanate is used to about 70% of polyol.

Foam can be made into slab stock and cut to shape, molded or poured into place, or applied with a spray gun. Many types of slitters are available for cutting the slab foam to any desired thickness and shape. Sheets are laminated to make cushions of varying stiffness. Slitters cut or peel the foamed block, giving sheets up to 300 yards in length and down to 1/16-inch in thickness. Longer runs, with slabs up to 80 inches wide, are now possible. Slab-stock can now be foamed 24 inches high, compared with six inches a few years ago.

Market for Foam

Urethane foam moved into a ready-made market in 1955, shortly after its introduction. Latex rubber foam had already penetrated the automobile, furniture, and bedding markets. Vinyl foam was sold commercially before urethane foam, but the latter, because of the price factor, has shown spectacular growth. Both have taken a large share of the market, not only at the expense of foam rubber, but also cotton, other textile cushioning and filling, and steel springs.

Foams of any type were virtually unknown to the public before World War II. From 17-million pounds in 1947, foamed latex rubber consumption increased steadily, reaching 100-million pounds in 1951, and about 180-million pounds in 1958.

Prior to World War II, the primary market for foamed latex was in transporation seating, such as bus cushions. Production was suspended during the war and, when resumed, expanded rapidly—particularly in the automobile industry. By 1955, 95% of all cars had some foamed latex seating. Between 1949 and 1953, a new market had developed. Bed pillows were being made of foam latex due to the rising price of imported down. The home furnishings market also boomed in this post-war period. Latex foam slabs became quite popular with the upholstery and do-it-yourself markets. The last of the markets entered by latex foam were the furniture and mattress fields. By 1955, about one-half of upholstered furniture contained some latex foam, although only 10% of the mattresses sold were made of foam rubber.

Then, along came urethane and vinyl foams. It was believed that the consumption of plastic foams and latex rubber foam would increase, with each finding a place in the various markets. Thus far, urethane foam sales have gone up from scratch in 1954, to 80-million pounds† in 1960—a volume 16 times that of vinyl foam. Foam rubber, on the other hand, dropped 10% in sales from 1954 to 1960. Padding and upholstery filling of cotton, sisal, and hair showed only a slight increase. Comparing foam rubber to urethane consumption, latex has about twice the volume sale; however, the cubic footage of urethane consumed is about 25% greater.

Overall, the non-foam padding and upholstery filling outsell the foams by more than twice. Chart 1 shows consumption figures for all types of cushioning except steel springs. In summation, urethane gains have come largerly at the expense of foamed latex, somewhat from textile fillings, and partly from general market growth.

The Furniture Market

Urethane foam has made its greatest penetration here, and this year's anticipated sales are 40-million pounds†, compared to 15-million in 1958 and under a million in 1954. Chart 2 shows urethane's increase again coming at the expense of latex and other padding and cushioning materials. More than 200 manufacturers are using urethane in some part of their lines.

Conventional foam rubber with its crowned surfaces and molded cushions is still rated high by the furniture industry (60-million pounds this year), and carries the greatest prestige with the highest price. Some pro-

† This figure and others for urethane are final consumption, not production figures; the latter being about 20% higher.

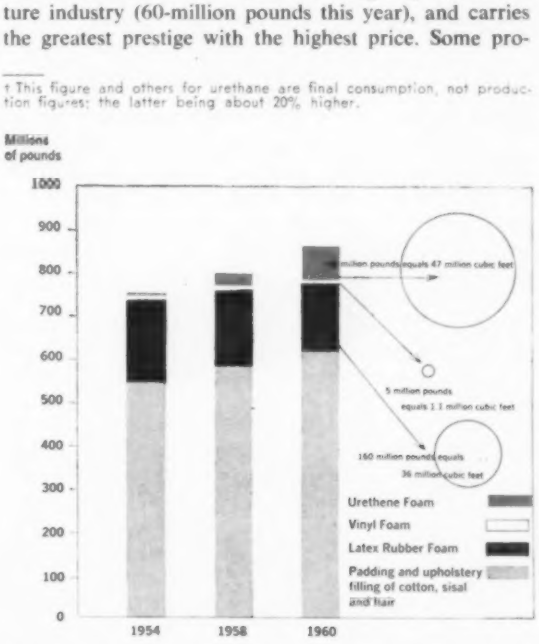


Chart 1. Consumption of cushioning and padding materials, millions of pounds

Source: Latex, padding, and upholstery filling figures for 1954 and 1958 from U.S. Bureau of Census; other figures estimated.

Note: A pound of urethane gives more than twice the cubic footage afforded by vinyl and latex. For 1960, average densities per cubic foot used in consumption figures are 1.7 for urethane and 4.5 for vinyl and latex. The urethane figures are material consumption, not production—which would be 20% higher. No conversion of textile fibers is possible due to the extremes in their density ranges.

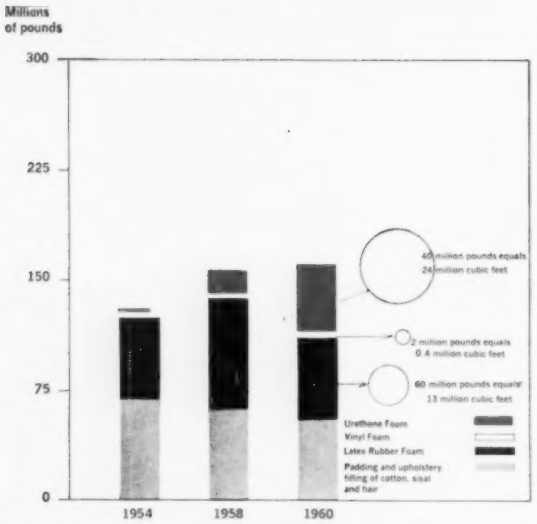


Chart 2. Consumption of cushioning and padding by the furniture industry, millions of pounds

Source: Latex, padding and upholstery filling, and furniture sales figures for 1954 and 1958 from U.S. Bureau of Census; other figures estimated.

Note: Densities of latex rubber foam and vinyls are at least twice that of urethane; therefore, only half the poundage of urethane is required to make a cubic foot of foam.

ducers have been offering foamed latex cushioning for over 10 years. Urethane has made tremendous strides during the past two years due to its toughness, comfort qualities, and relatively low price (about 40% less than foam rubber). It can be used to replace latex and springs—a contoured urethane cushion with a flange can be joined to a plywood base in one operation.

Many believe that as a competitor of latex, urethane will be confined to the middle- and lower-price brackets. It is, however, being used in some high-priced lines in combination with synthetic fillers as a substitute for spring-down cushions.

At present, urethane both complements and supplements foam rubber. There has been a sharp increase in the use of polyether based urethane as a padding material and an increase, not so large, in its use as a seating material. Foam sales have accelerated because of the influence of Scandinavian styling in furniture. The simple, square, modern designs are made-to-order for foam slab users. As a result, all types of foams have replaced 80% of the springs in furniture cushions. These same designs allow cutting of urethane slabs, allowing it to compete in some cases with molded latex rubber. In addition, the different densities available in urethane foam permit various desired degree of cushioning for the different requirements of arms and backs in modern, slim-line furniture.

Urethane foam has many competitive advantages. Compared to latex, it is lighter, has better tensile strength, and it can be better used with textiles permitting more efficiency in sewing, stitching, and stapling. Traditionally-expensive furniture is now available in medium prices because arms and backs can be sculptured and tufted more economically with urethane than with latex. Urethane foam grips better than latex, keeping the fabric welting in place and allowing wider application of zippers to upholstery. For padding and filling materials, urethane foam in slab stock can be applied easily, faster than animal hairs and textile fillings. The final product retains its shape better and is more comfortable.

Urethane foam is being used in a great variety of ways. It can be surrounded by Dacron, or in quilted batting. Rubber webbing bases with loose urethane foam seats and back cushions are employed in both high-fashion moderns and Early-American groupings at what the trade quotes "at about the same price as springs, but is considered to be more comfortable." One firm, in an exposed-wood pull-up chair, uses a web base topped by a one-inch muslin-covered urethane foam cushion which rests on a two-inch foam rubber seat. Urethane cushioning also permits one designer to bring out a one-inch thick "eggshell" lounge chair of molded plywood. The material also makes good topping for slip covers.

The Automobile Market

Urethane foam use is gaining rapidly in the automobile field, moving from 6.8 million pounds in 1958 to 20 million pounds in 1960 (see Chart 3). The automobile has many uses for flexible foam; seat toppers, entire seat cushioning, arm rests, upholstery backing, floor mats, underlays, roof insulations, crash paddings, and door weather-stripping. It is here that urethane has made its deepest cut into latex sales, which show a 40% decline since 1954. Other padding materials (hairs and textiles) have also declined in sales to the automobile industry.

At present, if urethane foam were utilized wherever possible in automobiles, about nine pounds would go into each car. Actually, less than half of that amount is now being used. The ultimate potential is estimated as

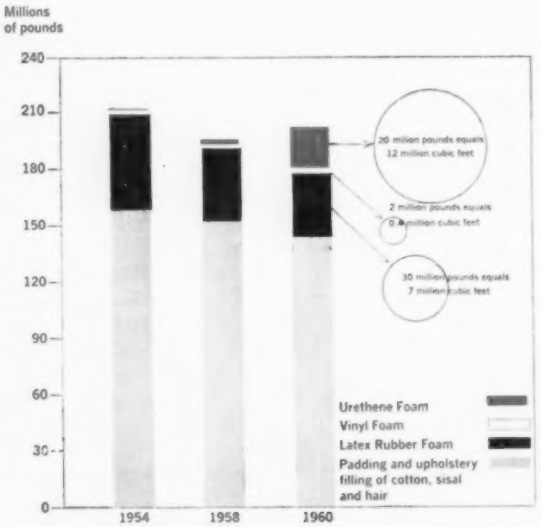


Chart 3. Consumption of cushioning and padding by automobile industry, millions of pounds

Source: Latex, padding and upholstery filling, and auto sales figures for 1954 and 1958 from U.S. Bureau of Census; other figures estimated.

Note: Remember, it takes only half the poundage to make a cubic foot of urethane foam, compared with latex and vinyl.

25 pounds per car.

With the development of polyether types, urethane foams in many instances are replacing latex in seat toppings. Latex foam had won almost universal acceptance for this purpose in the U. S., since it provided better comfort than previously-used materials. The polyether-type foam has given urethane the resiliency and comfort characteristics so necessary in automobile seating. Its aforementioned high tensile strength, lighter weight, flame resistance, ease of fabrication with upholstery, and ease of assembly (it requires fewer insulating layers of fabric between springs and foam) are also factors.

Urethane foam first moved into the low- and medium-priced car fields as seat topping, then in the more expensive cars. It is being used for second and third seats in station wagons, and on platform seats over tunnel areas in all types of cars. Even in this area, urethane foam still has much of the market to conquer. Complete seats of either urethane or latex foams are still in the experimental stage. Elimination of springs would allow lower seating, so essential for streamlined purposes. If this comes about, it is estimated that each car would require 13 pounds of urethane foam and, at present car output, would absorb 80-million pounds, an amount larger than now purchased by all consuming industries combined!

With the trend toward safety features, the automobile industry took quickly to instrument panel trim and crash pads of urethane foam, based on its superior ability to absorb shock. Though more costly than non-foam materials, its ability to take the direct shape of any object is an important factor in the switch over to urethane foam. An embossed, flexible, thermoplastic sheet is vacuum-formed to the outer surface of the pad, which is then placed in a mold. Urethane foam formulation is poured, and the mold is closed. After the foam is cured, the mold is opened and the part trimmed. About one pound per car is used for this purpose.

Arm rests, too, are being molded with the urethane foamed-in-place over a vinyl skin and around a molded-in metal insert for attachment to the door frame. Armrests were formerly made with a molded base, built up with sponge rubber, and then covered with fabric or skin. Other items such as visors, instrument panel pads, and horn button pads are made by the same technique, saving assembly time so important in the automobile industry.

Because urethane foam can be prepared to a high compression value with a comparatively low density, it has begun to make some inroads as auto floor mat underlay material. The foamed-in-place also has appeal for this use. Since urethane can take rougher wear than latex, its advantage is obvious. As backing for mats and carpeting in automobiles, urethane foam provides a luxurious feel and permits the floor covering to drape over floor contours without wrinkling.

Since latex foam cannot be used where directly exposed to weather, urethane foam is finding some application as door seals and weatherstripping. Urethane is also superior to latex in its insulation properties and, with the popularity of air conditioning in automobiles, its use may be extended. It is already being used for air conditioning blowers, heating, and housing. Its use for car top insulation is underway.

Urethane foam is widely used for the same purposes in aircraft, where it is even more essential due to weight saving. The modern jet liners are using urethane foam for seat cushioning; mattress padding; protective padding on hatracks, sides of planes, and berth covers; carpet underlay; and cushioning in cockpits. It is estimated that weight savings come to 50% when urethane replaces other materials. For seating urethane not only is one-half the weight of latex, but also is flame resistant. About six pounds of urethane are used per seat in a plane. In the new large jets, urethane seating saves about 1,000 pounds. Although a plane can use a sizeable amount of foam, only about 5,000 planes per year are produced and replacement demand is virtually non-existent. Estimated aircraft demands could approximate one-million pounds per year.

Public Seating

Closely allied to automobiles and planes is public seating. Urethane, with its above-mentioned characteristics, is well suited to take over its share of this market. In fact, such characteristics of urethane foam as fire-resistance, excellent oil- and chemical-resistance, and solvent- and grease-resistance, render it superior to latex foam. Vinyl foam has the same characteristics; however, urethane is cheaper. The technical, comfort, wear, and safety features of urethane have been tested and accepted for use in busses and trains operated by the New York City Transit Authority, although reinforced plastic seats are also in competition. Some molded urethane cushions for transportation vehicles have been manufactured, not only on busses, but also in tractor seats, industrial equipment seats, bicycle seats, boat cushions, and seats in auditoriums, theatres, and gymnasiums.

The total volume potential here is difficult to ascertain. The amount of public-bus seating is relatively small, since only about 2,000 busses were produced last year, and the replacement rate is almost nil. A better prospect is the school-bus market, for which 25,000 vehicles were produced in 1960. Unfortunately, the manufacturers of this type of bus feel that cotton batting is adequate for the seats.

Bedding Market

Foamed latex accounts for about 10% of the 12-million mattresses now produced annually. In 1958, about 24-million pounds of latex were absorbed by the mattress industry, an amount almost equal to 1954 consumption. In addition, an estimated 15 million pounds were used for hospital toppers and bedding. For 1960, the use of latex foam will be about the same as in the past. The bed-pillow market, too, has held constant with a little more than 12-million pounds being used in 1954 and 1958, respectively, and about 15-million pounds expected for this year. In this area, latex foam seems to be holding its own.

Up to now, urethane has hardly made a dent in either the mattress or bed-pillow market. If four-million pounds are to be used in mattresses, and two-

million pounds in bed-pillows, it should begin to show in 1960 (see Chart 4).

Recently, urethane foam mattresses have been promoted for their superior durability, ease of cleaning, freedom from odor, non-allergenic properties, and resistance to dry-cleaning solvents, oils and perspiration. The New York State Department of Mental Hygiene has been testing these new mattresses under conditions far more rigorous than found in any home. Two years of service indicate that they may last 6-10 times as long as other mattresses.

A twin-bed mattress made with polyurethane weighs about 16 pounds, or one-quarter the weight of a comparable inner-spring unit and about one-half the weight of a foamed latex unit.

Other Markets

The following markets have hardly been tapped; in some of these industries the use of urethane has already begun, while in others its consumption is still in the experimental stage.

PACKAGING: About three-million pounds of urethane are absorbed by this market. Urethane foam can be slit into very thin sheets, down to a 1/32-inch thickness under certain conditions. It can be used for wadding, padding, and cushioning for all types of breakable and sensitive objects such as electronic and other instrument parts.

CLOTHING AND TEXTILES: The prime advantages of urethane foam in this industry are its lightness and insulating characteristics, so essential for today's concept in apparel-functional performance without weight. It is easily worked alone or with fabrics, and can be stitched with conventional equipment or bonded electronically. It can be embroidered, screen printed, cut out with die clickers, and attached to fabrics or films with certain adhesives. Its temperature resistance and resistance to solvents and chemicals adapt it to all standard techniques of dry cleaning, laundering, and sterilization. It will not mildew, is not subject to attack by moths, and has twice the insulation value of cork. As noted above, it can be cut very thin and handles like a textile fabric. A sportswear manufacturer is using 3/8-inch thick urethane for insulation in jackets to replace heavier cotton batting. A topcoat of jersey or other thin woolen laminated to a weightless 3/32-inch of flexible urethane foam will give warmth without bulk.

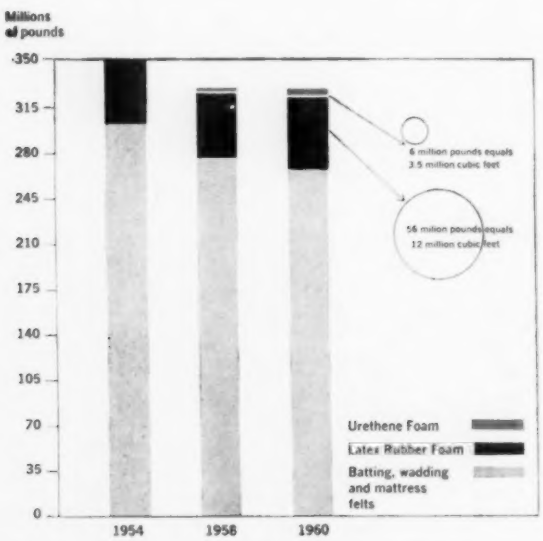


Chart 4. Consumption of fillings for bedding, millions of pounds

Source: Latex and batting, wadding, and mattress felts figures for 1954 and 1955 from U.S. Bureau of Census; other figures estimated.

Bulkless snowsuits that weigh ounces instead of pounds, men's and women's car coats and sports jackets that are exceedingly light in weight are being marketed. Other important uses include shoulder pads, corsets and bras, hat bands, and gloves. Volume consumption has risen from 10-million square yards in 1958 to 30-million square yards in 1959, and as much as 50-million square yards are expected to be absorbed in 1960. Apparel interlining consumed 500,000 pounds in 1958, and should absorb two-million new pounds in 1960. Most of the items mentioned have never used latex foam, and thus provide urethane with unique opportunities.

RUG UNDERLAY: Foam rubber for carpet underlay has always been considered a luxury item since the material is not strong enough to be handled without a fabric backing. Furthermore, its cost is increased because it must be molded to a set thickness. Urethane foam, on the other hand, has superior abrasion and tensile properties and can be slit into suitable sheets from larger slabs with standard slitting equipment. In addition, a urethane foam underlay does not support combustion and provides enough friction to prevent crawling. Urethane foam can be applied directly to the back of carpeting, providing not only a cushioning effect as do most underlays, but also acting as a base for supporting the carpet pile.

TOYS AND NOVELTIES: Slab stock in any desired thickness is readily produced, and assorted shapes can be die-cut on conventional machinery.

SPORTING GOODS: There are many uses for urethane in the sporting goods field, the majority of which are relatively small-volume applications taking advantage of the foam's shock-absorbing properties. Protective headgear liners for such sports items as football, racing, hockey, lacrosse, and polo, as well as boxing gloves, baseball gloves, and gymansium mats and apparatus are all good potential markets. It is used in individual pads and protective devices including knee pads, shoulder pads, nose guards, athletic supporters, and hip pads. Other sport uses include durable fishing floats, casting rod handles, gun stock pads to absorb recoils, golf club grips, marine life preservers, and sleeping bags. All types and kinds of beachwear, from floats to beach pads and beachwear are available for outlets.

FOOTWEAR: Urethane foam can be used for shoe innersoles because of its light weight, shock absorption, and high tear resistance; and for outersoles in certain types of athletic and dancing shoes. Tennis and basket-

ball shoe soles are also made of this foam.

HOUSEHOLD ITEMS: The articles using urethane foam in some form are innumerable, and include kneeling pads, scrubbing pads, polishing pads, paint rollers, wax applicators, floor mops and brushes, dish mops, bath mats, clothes brushes, placemats, hot-plate insulating mats, table cloth underlays, ironing board covers and pads, playpen mats, door mats, and baby toys.

CONSTRUCTION: Urethane foam is beginning to have important use in this area as weatherstripping, door seals, padded interior decorative paneling, and above all, as insulating material. For example, urethane foam is being used as insulation between steel paneling for all types of building, as well as for insulation around hot pipe-lines and for heater housings.

INDUSTRIAL: The uses in this area are extremely numerous. Almost all equipment, machinery, instruments, appliances, and transportation vehicles and equipment have some need for shocking and cushioning materials. This includes gaskets, mounts, platforms, air filters, machine and office pads, safety liners, and padding for door closures. For example, seals and vibration dampeners made of urethane foam encased in vinyl tubing are offered for various industrial uses. This item, supplied in any length from ¼- to ¾-inch thick, is soft, flexible, and can be compressed to a fraction of its diameter with full recovery when released. Urethane foam is being used as an air seal in dairy cooling cabinets, and as a dampener in aviation radar units. Combining terminal insulation and shock absorption, it can be applied in air conditioning, refrigeration, and soundproofing.

Another example is a new industrial respirator made of urethane foam, permitting plant personnel to breathe safely and comfortably in temperatures up to 300° F. Such respirators are used in kilns, ovens, and furnaces which are considered too hot for more than a few seconds' endurance without the respirator. Urethane foam is effective in absorbing sound and is applied to ceilings and walls for this purpose, as well as on earphones of testing equipment to reduce or eliminate noise.

MILITARY: There are a host of items, some comparable to those used in civilian life, as well as those specifically designed for the Army, Navy, and Air Force. In the more glamorous items, urethane is being used in missile and space ships, nose cones, and pressure suits for insulating purposes; the astronauts of the future will have space couches made of this material. Urethane foam is used to fill structural voids in atomic submarines not only for its lightness, tensile strength, and flotation, but also for its high insulation characteristics. Floats made of urethane are used in conjunction with mine-sweeping cables. Urethane crash pads for military vehicles such as tank interiors, and its buoyancy characteristics make it ideal for aircraft, marine vessels, and life preservers.

Future Market Potentials

Future markets for urethane foam depend both on extension of such present markets as furniture and automobiles, and penetration into the fields which have hardly been touched. Urethane foam, commercially marketed for only five years as compared to the 15-year period for latex foam, has done exceedingly well. Two basic essentials, foam quality and price, are the keys to the future of all markets, although each specific market has its own problems.

As previously stated, urethane foam is made in large continuous buns, compared to the almost exclusive closed-molding of latex foam rubber. Fabrication of straight line, square-cornered articles is most efficient, economical, and low-priced when made from buns. However, when rounded corners, shapes other than right angles, and crowned tops are needed, the urethane foam must be cut and buffed. This involves higher labor costs and waste materials, both of which increase the foam's final price. Urethane foam has made its greatest market penetration at its lower price where straight-line, square-corner articles like Scandinavian furniture predominate. To compete in other type markets, molding technology for urethane foam must be substantially improved.

The one-shot polyether system, the result of improved catalysts and stabilizers, is making possible a uniform molded urethane foam. However, until the reactivity of the mixture can be completely controlled and suitable release agents found, the product will not be commercially competitive with latex rubber foam. The industry is working intensively to develop the closed-molding technique.

Costs and Prices

By comparing the 13-15c price per board per foot for urethane foam to the 22-25c price for latex foam and the 20-25c (molded), 35-40c (slab) price for vinyl foam, the user does get the true cost picture. If the urethane can be cut into parts without waste (other factors being equal), it has a decided price advantage over the other foams. On the other hand, the cost penalty of the open-molding process for urethane foam involves a large amount of waste when the rounded tops of the buns are cut off and the edges of the articles are cut and buffed. Of course, this waste can be sold at a lower price for stuffing uses. The trim loss from the original cut slabs without further fabrication allows urethane foam to be priced less expensively than molded latex foam. When the cut slabs need further fabrication, though, molded latex foam is less expensive. Only the fully-controlled, closed-mold urethane foam technique will make this product less expensive than latex foam.

The key to understanding the price of a particular foam is its density in relation to its useful properties. In part, the potential market depends on these factors. The basic measure of a foam's cushioning value is its R.M.A.# compression resistance (the number of pounds necessary to compress 50 cubic inches of foam 25%). Changing the chemical composition or mechanical characteristics changes its compression. Foam rubber is considered to have the highest standard of

RMA compression—standards set by the Rubber M'fg'rs. Assn.

cushioning comfort. However, the compression characteristics of the recently developed polyether-based urethane foam are very similar to those of latex. Coring or contour cutting imparts compression characteristics that solid foam does not have, and cuts costs.

Almost all the foams on the market have compressions between 18 and 30 pounds.

Urethane foams, with standard 25% compression of between 18 and 30 pounds, have a density of 1.7-2.5 pounds per cubic foot, compared to 5.5-6.5 pounds for uncored latex (3.6-4.3 lbs./cu.ft. cored). Vinyl foam density ranges 4.5-5.0 pounds per cubic foot, and compression values between 12 and 18 pounds.

Consequently, urethane foam takes about one-half the raw materials to give the same compression. This accounts for the lower cost of urethane, especially when slab form can be used without further fabrication. Of course, in the open-molded slab process now being used with urethanes, there can be as much as a 25% trim loss. There is no trimming with the closed-molding process which is used with latex and vinyl foams. Slab urethane costs can, therefore, be slightly higher than molded cored latex when all cost factors are considered. It is obvious how much lower urethane costs will be when the closed-molding process is fully developed.

The cost of raw materials going into urethane foam is going down steadily, especially that of tolylene diisocyanate, and this trend is expected to continue. On the other hand, there has been an increase in the price of natural rubber. As a result, the lower—and more stable-priced synthetic rubbers are being used—with inorganic fillers. Present studies indicate major changes in the urethane foam process. The one-shot method was introduced recently, along with new catalysts and stabilizers, to cut costs. The momentarily-anticipated closed-molding process will trim these costs even more. There have been no real changes in the latex rubber process over the past 15 years, and none are expected.

If the anticipated process changes take place, all types of urethane foam will be priced lower (for specific uses) than the corresponding foamed latex. Then, urethane can take over more of the market now held by foam rubber.

New Markets

Expected technical developments will not only provide added business in the already-penetrated fields (furniture and automobile), but in many other markets which require molded foams. Even without these developments, many of the minor markets can become major.

For example, the packaging field with a potential of $250-million for padding and cushioning materials has hardly been scratched by urethane. This is basically a design problem, and the trouble lies in a misunderstanding of foam capabilities and over-designed products. Actually, more foam material is used than required, thus increasing the price to the customer. This keeps the largest percentage of the packaging market out of the reach of foams.

Substantial research is required to tailor the urethane foam to the specific needs of the packaging market. Urethane foam is 30% more efficient as an energy absorber than is rubberized hair. Why is it not possible to cut down the amount of foam, reduce the overall cubic volume of the products, and pass on savings not only in foam costs, but also in container size and shipping weight? Similarly, by reducing density and cutting the urethane foam to thicknesses, lengths, and sizes as required, would permit this material to capture its share of the market.

Another consideration in marketing urethane foam is the overall cost savings. In many instances, considerable savings result by reducing overall weight and cubic volume, eliminating labor costs, facilitating package-size standardization, and reducing warehouse and inventory costs.

Research is necessary to market many of the items mentioned in previous sections. The work done in apparel has increased urethane foam consumption fivefold in three years, but much remains to be done if it is to reach its total potential in textiles and apparel. The quality, consistency, and correct formulation of urethane foam for each specific market must be worked out in detailed research. Then, some of those markets which are usually lumped as "all other" can well become larger than the present natural markets in the furniture and automobile industries.

Market Forecast

A statistical look into the future of plastics consumption, especially urethane foam, is fraught with "ifs." If changes take place in the next five years as they have in the past, the poundage of urethane consumed should triple (see Chart 5).

One pound of urethane foam goes almost twice as far, volume-wise, or per cubic foot, as does latex or vinyl foam, and much further per cubic foot than do cotton batting and steel springs. Therefore, the tripling in consumption in terms of pounds of urethane foam means a substantially larger increase in cubic feet consumed. Furthermore, it is assumed that other available foams will be improved, and that new foams

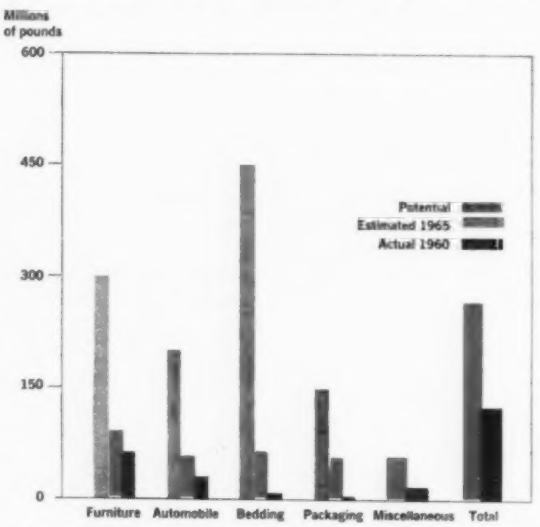


Chart 5. Markets for polyurethane foam, millions of pounds

will be developed and also capture their share of the market.

The present natural markets for foam in furniture and automobiles should, in the former case, double in poundage consumed and, in the latter case, triple in the next five years. If all-foam seats become commercially feasible, consumption may be even greater. Within five years, urethane should become a real factor in the bedding field and consumption should increase ten-fold. The use of urethane foam in packaging can be expected to quadruple during that period.

Some of the greatest gains are expected in the unpenetrated markets analyzed above. Major applications are expected in packaging, pipe insulation, construction insulation, acoustical uses, filtration, garment interlining, as part of apparel with fabrics, and in many novelty, toy, sport, and swim items, as well as in many military uses.

Some market forecasts for the next five years differ from the above, anticipating larger increases in urethane foam sales to the furniture and automobile industries and smaller increases to bedding, packaging, and industries other than shown in Chart 5. This survey does not agree, feeling the cream of those two markets will soon be skimmed. The greatest sales expansion should come from more concentrated effort in the hitherto unpenetrated markets.

Structure of Industry

The industry is constructed like a pyramid, with a limited number of raw material producers at the top. At the next level, and much more numerous, are the commercial producers of urethane foam. In 1955, there were only a handful; now 50 firms are manufacturing urethane foam. Next come the hundreds of distributors; most specializing in a specific market and sub-markets, and by area. They, in turn, sell to thousands of foam users.

The channels of distribution do not necessarily follow this straight line. For example, the chemical companies only make the raw materials and sell to foam manufacturers, while the rubber companies make both the raw materials and the foam itself. Also, the manufacturers of foam may use distributors as they do for the furniture industry, yet sell direct to the automobile industry. Large consumers manufacture their own foam in-place; purchasing the raw materials only and by-passing the remainder of the distribution set-up.

Urethane foam is sold as slab stock and, to a limited extent, as a molded product, or as a captive "in-place" operation. Slab stock is the volume business, and goes mainly to the cushioning market. The regular foam manufacturers ship the slabs as they come off the production line, but in sizes which can be handled. Distributors who also sell other types of foams, cut the buns into sheets, and fabricate the foam to each customer's specifications. The distributor is charged for the number of usable board feet he can obtain from a bun. Distributors who sell to markets other than furniture have equipment to fabricate the types of foam shapes needed by the diverse markets.

The question "who markets the product? (not only sold, but market-researched, advertised, promoted, and merchandized)" has not been answered. Is it the raw material producers, the foam manufacturers, the distributors, or the makers of the finished articles? Some marketing has been done at each level, but nowhere is there a clear-cut marketing program to push the product in the myriad potential markets.

A serious problem in marketing involves the role of the distributor. With a very small mark-up or commission, corners are cut in the quality of the product sold; insufficient attention is paid to the needs of the users; little research is undertaken to design, cut, and fabricate the urethane foam to the needs of markets other than furniture and automobiles; and there is a lack of sufficient advertising and promotion in areas other than major markets. Other than in the few markets (like automobiles where direct selling from foam manufacturers is undertaken), the distributor holds the key to market penetration. He is in direct contact with the maker of finished items using urethane foam. Price-cutting, and the realizeable furniture market, have resulted in little interest among the distributors in obtaining know-how, equipment, and marketing organizations to serve markets other than those that bring immediate returns.

Urethane foam has been sold basically on price, and as a substitute for existing materials. Of course, certain physical characteristics have had to be met. Hence, the problem of price-cutting has entered this infant industry, leading to the inevitable poor marketing.

Until now, marketing of plastic foams has suffered from what has been ailing all plastics despite phenomenal growths. Sold as a substitute rather than as a material with qualities in its own right, many superior properties are overlooked that can add important characteristics, not now possessed by existing materials, to the finished product. A positive approach will have a strong bearing on the price situation. Once the distributors (with the help of foam makers and manufacturers of raw materials) sell the makers of the finished items, the public will then be sold with the assistance of the manufacturers of the final articles.

Conclusions

Urethane foam has come a long way in five years and sales will soar in the future. How quickly, and how far, will depend on when closed-mold urethane foam will be commercially feasible on a wide scale; when urethane foam can be standardized to know that the same product chemically and physically obtained in every instance; when urethane foam is sold on its own merits and not as a substitute; when sufficient research is undertaken to cut, pattern, tailor, and fabricate the foam to the requirements of each of the untapped markets; and when a marketing structure is developed to permit needed market research, determination of consumer desires, and allowance for sufficient advertising, promotion, and merchandising.

—The End

Since this article is non-technical, would you please comment, pro or con, and send to Arthur M. Merrill, Editorial Director

Tiros II—
Plastics as satellite optics

A 1½-ounce device measures earth's temperature—depending on plastic to focus infrared rays

RUSSELL DeWAARD*

One-and-one-half ounces. That's the total weight of a two-channel radiometer built by Barnes to serve as one of the major instruments in the just-launched Tiros II. This weather satellite, the latest in a series of experiments being conducted by the National Aeronautics and Space Administration (NASA), is designed as a more sophisticated successor to a similar satellite, Tiros I, sent aloft in April of this year.

Tiros II is of particular interest to the plastics engineer, because the two-channel radiometer owes much of its success to a thin plastic film. In fact, except for its base-plate, a few resistors, some less-than-hair-thin platinum wire, and the two radiation detector flakes, the radiometer is practically all plastic. Even the conical, optical elements used to gather infrared and other radiation from the earth for condensation on the detector flakes are formed from a thin sheet of polyester (Du Pont's Mylar).

The material was selected because it has low thermal conductivity, is stable, strong, light, readily cemented to itself and metals, and easily vacuum-coated. Furthermore, in this particular application, it does not degas. This is critical in the vacuum of outer space where the radiometer must function. High-intensity, random vibration does not harm the plastic film; therefore, the shock of take-off will not destroy the instrument.

Plastics are also used to insulate the aluminum base, to encase precision resistors, to seam the cone and cement it to the base plate, and to form the mounting grid which holds the detector flakes.

Function of Radiometer

Acting like a remote thermometer, this light-weight radiometer is capable of measuring the earth's temperature. Having two channels—one white, the other black to correspond with the painted color of the thermistor detector flakes—the instrument also permits comparison between total solar energy received by the earth and the long-wave thermal energy emitted by it. This gives meteorologists a measure of the earth's efficiency in absorbing solar radiation. Called 'heat balance," this factor is known to have a major influence on our weather, and is being studied in the hope of making weather forecasting still more reliable. In fact, it is not at all far-fetched to suggest that some day this little radiometer may help in predicting a "white" Christmas.

Optics for the radiometer are constructed as follows: Using a metal template, the contour of the condensing cone is cut out of 0.002-inch polyester film. This shaped blank is held around a jig with string (much like winding up a spinning top), and a thin strip of polyester cement is inserted in the seam. Curing in an oven at 160° C. for about 10 minutes polymerizes the cement and firms the cone, which is then trimmed to exact size.

Two cured and trimmed cones are secured to the aluminum base plate with the same polyester cement

Plastic parts for the Barnes 2-channel radiometer include liquid polyester and hardener, solid polyester strip cement, multifilament acrylic grids, polyester optical condensing element, cover disc for detector flake, and polyester-covered resistor.

* Head, Applied Physics Section, Barnes Engineering Co., Stamford, Conn.

in liquid form. The base previously received a 3-mil layer of polyester to act as insulation, and a thermistor head had been mounted in its center to read base-plate temperature. A different jig is used to assure proper alignment between the cones and base.

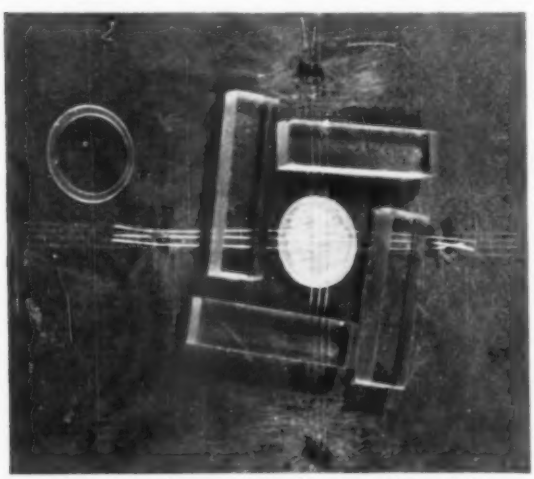
Up to this point, the cones are transparent. Their "outside" surfaces (those which will face towards earth or outer space when the satellite is in orbit) are then vacuum-coated with aluminum after first cleaning with acetone and masking-off the base-plate.

The heart of the radiometer is the thermistor detector flake, which is capable of absorbing radiation and changing in resistance as it heats up. These minute resistance changes are telemetered to monitoring stations on the ground. By comparing the signals received from the white and the black channels, meterologists are able to determine the efficiency with which the earth is absorbing the sun's radiation. To minimize heat losses from the thermistor flakes, each is thermally-insulated from the rest of the radiometer by mounting each on a 6-strand grid formed by strands of polyfilament acrylic fibers. Thickness of each strand is about 3 mils.

Grids are formed using a thin (0.003-inch) washer of polyester like a miniature embroidery hoop. Each grid is tautly cemented into place, and reinforced with another such washer on top. The completed grid is mounted to the top of the cone.

Thermistors flakes for the black and white radiometers are then carefully mounted on the grid, each trailing a thin platinum lead wire. Thin, in this case, means 0.0005 inch, or about one-tenth the thickness of a human hair. The thermistor flakes are cemented into place with liquid polyester, also used to tack the platinum lead to the cone. The lead is first wrapped around the acrylic grid a few times to keep it from tearing when the satellite is launched.

Polyester discs are sized to seal off the cone end and cemented over the detector flakes. Also, thinned polyester is applied to the active side of the flake to insulate it from the black or white paint coating which is applied later. Electrical connections are made to resistors and to a special connector. In both cases, plastics again play an important role.



Six strands of 20-filament acrylic fiber form the grid for supporting the detector flake.

Stages in the assembly of Barnes' 2-stage radiometer. Quarter indicates relative size, pointing up the fact that miniaturization can be achieved with plastics.

Radiometer's transistor covers the radiometer's transistor to prevent shorting and protect against heat.

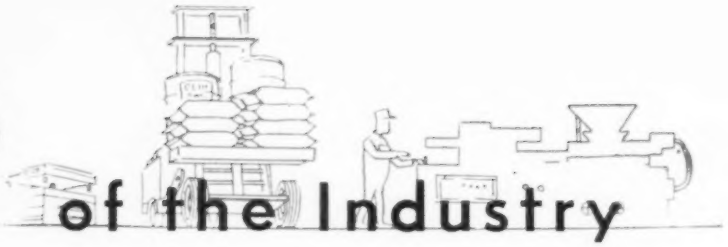
Because the resistance value must be extremely precise, standard production units cannot be used. Instead, a resistor is brought to the desired value by unwinding some of the resistance wire. To protect the finished resistor and, more important, to have an insulated surface along which connecting wires may be run without shorting, a new polyeyster jacket is fashioned and cemented over the windings. The original resistor jacket cannot be used because it does not have the same high-temperature capabilities as the polyester.

Now, gold is vacuum-deposited onto the back side of the two cones, i.e., the side which faces toward the inside of the radiometer. This coating minimizes radiant heat transmission from the satellite itself to the detector flake, and prevents erroneous readings.

After the multi-pronged connector is cemented onto the base plate and a chromel-alumel thermocouple is attached, the radiometer channels are calibrated in an environmental chamber. The remaining circuitry is completed, and electronic components positioned. Liquid polyester is applied to all wires and sensistors, and cured for the last time at 160° C. After one of the flakes has received a baked coating of a special white paint and the other black, the top of each cone receives a thin layer of polyester and a final coat of gold. One more check for short circuits, and the radiometer is ready for delivery.

—The End

NEWS of the Industry



business developments

H. W. North Co., Inc., recent affiliate of National-U.S. Radiator Division of Crane Co., has resumed independent operations as designers and suppliers of chemical process equipment and special purpose machinery. New headquarters are in New Cumberland, Pa.

Reeves Brothers, Inc., has taken over the manufacturing, laminating, and merchandising of Curon foam from Curtiss-Wright Corp. Reeves had formerly acted as sales agents.

Rexall Chemical Co., a division of Rexall Drug & Chemical, announced plans to construct a polystyrene manufacturing unit in the Midwest, with initial capacity set at 25-million pounds. Rexall also plans to enter the polyethylene market under resale agreements until its own 120-million pound plant opens in early 1962. The firm eliminated Seamco and Granada as polystyrene brand names (it already has 2 units in operation—in California and Massachusetts), establishing the new Elrex trademark.

Phillips Chemical Co. is shipping Marlex resin in 3,500 cubic-foot hopper cars which hold about 110,000 pounds of the high-density polyethylene.

General Foam Products, a subsidiary of Stauffer Chemical, is now producing polystyrene foam in blocks and boards measuring up to 12 feet long by 4 feet wide by 18 inches thick.

Norton Laboratories, a subsidiary of Auburn Plastics, has expanded its custom molding facilities, adding both equipment and personnel.

Seiberling Rubber Co.'s plastics division has installed one of the world's largest calenders (weight—100 tons +), which will double production of rigid thermoplastic sheet.

new plastics companies

Aard Plastics, Inc., is a new extrusion firm located at 169-175 Linwood Ave., Paterson, N. J. President and founder is Herb Weber, one of the pioneers in plastics extrusion and former president of SPE's New York Section. Mr. Weber had been associated with Rotuba Extruders and Waljohn Plastics since their inception.

Dennison Mfg. Co., Framingham, Mass., has formed a subsidiary, Howard Plastics Co., Inc., which, in turn, purchased the land, buildings, and injection molding equipment of D & D Industries, Inc., Leominster, Mass. Howard will do injection molding and blow molding, specializing in packaging, and D & D will continue in baby toy specialties. Temporarily, D & D will rent space from Howard.

price changes

Plax Corp., Bloomfield, Conn., has announced price reductions of 16% or more for certain categories of Polyflex, its biaxially oriented polystyrene sheet. New prices apply to general purpose and forming grades in gages 5-20 mils.

changes in ownership

Vansul Corp. & Colors, Englewood, N. J., has been acquired by Interchemical's Color & Chemicals division. Present staff will be retained.

Hapman Corp., Kalamazoo, Mich., has acquired Klenk Epoxy Corp., Detroit manufacturer of epoxy glues. The parent organization is a producer of tubular, industrial conveyors.

Dormeyer Corp., Chicago, has acquired Camfield Fiberglass Plastics, Inc., of Zeeland, Mich., and will operate it as a wholly-owned subsidiary. The merger is expected to give Dormeyer access to a wider range of applications in the housewares and power tool markets.

changes in address

J. P. Frank Chemical & Plastic Corp. has moved its general offices and showrooms from Brooklyn to 390 Fifth Ave., New York City.

agents, distributors & agreements

AviSun Corp. has named Dixon & Co., Denver, as Rocky Mountain distributor of Olefane polypropylene film.

Mitchell Plastics, Inc., Pittsburgh, has been named a certified fabricator for G-E Textolite industrial laminates used in the manufacture of circuit boards, tube sockets, and terminal strips.

Andouart of France has appointed Thermoplastic Equipment Corp., Stirling, N. J., exclusive agent for its Helicolor wire coating machine in the U. S., Canada, and Mexico. The unit insulates wires with helical colored stripes in PVC, polyethylene, and nylon.

Physical Sciences Corp., Pasadena, Calif., has appointed H. I. Thompson Fiber Glass Co., its sales distributor for high temperature and pressure wire, connectors, and potting compound.

CELANESE
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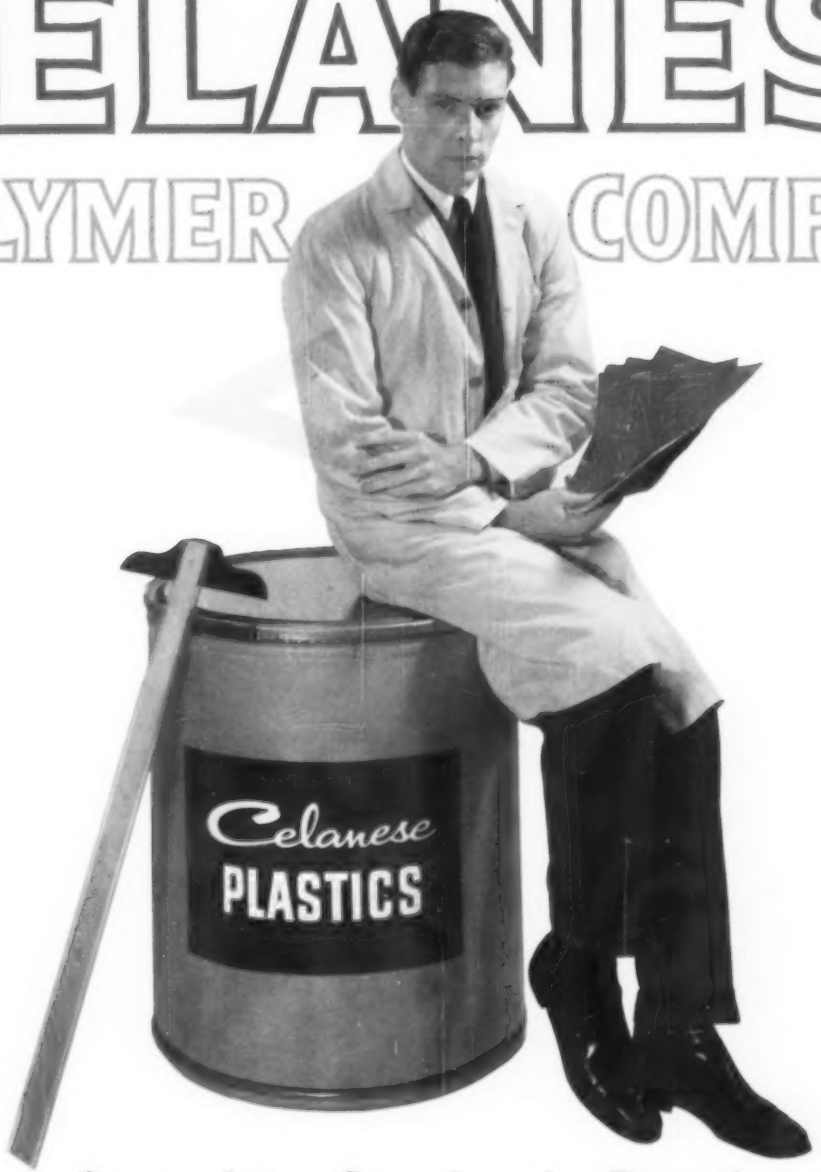

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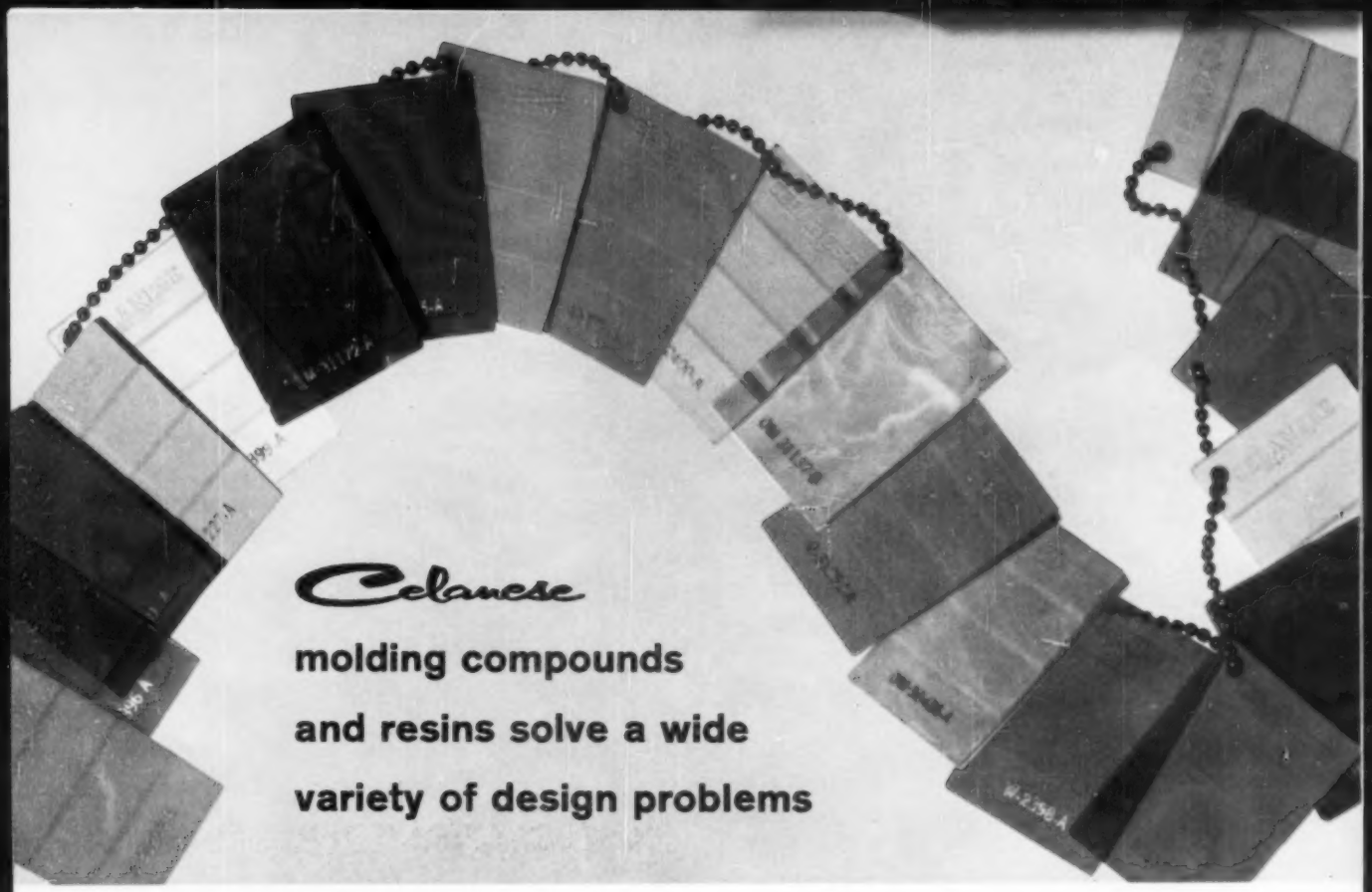

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Celanese PLASTICS

news from abroad

Japanese plastics industry hopes to raise this year's export figure from 37,589 to 53,930 tons, with vinyl accounting for the lion's share.

Rumania. Icechim of Bucharest has patented a new method for producing polyethylene involving the use of titanium tetrachloride. The material is obtained under pressure of some 2,000 atmospheres, at a temperature of 200°C.

Australia. A 12-story office building in Melbourne is faced with large infill panels of blue porcelain enameled steel having a core of rigid polyurethane foam and reinforced with metal tubes. Panels are produced by the Korlite process.

B. F. Goodrich—CSR Chemicals are to manufacture PVC in Australia, using ethylene produced by CSR—Dow Pty. Ltd. The latter company will also manufacture styrene monomer.

Russia. Local investigators have succeeded in the experimental production of transistors and other semiconductors from mixtures with polyacrylonitrile. They not only replace germanium, but are said to have a longer service life and are light in weight.

new plants, labs & additions

Imperial Adhesives, Inc., has completed its plant in Cincinnati. The unit covers 25,000 square feet.

Northwest Plastics, Inc., is building a new plant in Grundy Center, Ia., and has formed a new subsidiary to operate it—Plastronics, Inc. The new factory will do compression, transfer, and injection molding.

Cadillac Plastic & Chemical Co. has set up sales offices in Toledo and Dayton, O., bringing the total number of branch offices to 18.

Pam-Pro Plastics has opened a plant in Menlo Park, Calif. The firm does thermoforming, and post-forming of thermosets.

Diamond Alkali Co. has announced the completion date for its multi-million dollar acetylene plant as late 1961. Location is Deer Park, Tex.

Shell Chemical Co. plans to build a polypropylene plant in West Deptford Township, near Woodbury, N. J. Initial capacity will be 80-million pounds per year.

Amoco Chemicals Corp. has enlarged the facilities at its Joliet, Ill., plant to boost dimethyl terephthalate capacity by 50%.

Borden Co. and U. S. Rubber Co. have selected a site in the Greater Baton Rouge area for the construction of a $50-million complex of chemical plants which will convert hydrocarbons into a dozen chemical products.

Pipe Line Service Corp., a subsidiary of American Steel Foundries, Chicago, has started construction of a steel pipe coating and wrapping plant in Youngstown, O. The 94,000 square foot facility will be completed in April.

Raritan Plastics Corp., Paterson, N. J., will erect a new plant in Oakland, N. J., in the immediate future. The 20,000 square foot building will have manufacturing facilities for heavy-gage thermoplastic sheet.

Archer-Daniels-Midland Co. plans to construct a new research center in Bloomington, Minn. Completion is scheduled for 1962.

Tri-Point Plastics, Inc., has opened a 10,000 square foot plant in Albertson, N. Y.

E. I. du Pont de Nemours & Co., plans to erect a Teslar PVF film plant at Buffalo, N. Y. Operations should begin by mid-1962.

Celanese Plastics Co. has leased a plant in Alta Loma, Calif., for the production of blow-molded polyethylene containers.

National Starch & Chemical Corp. has opened a 14-million pound polyvinylidene chloride plant in Meredosia, Ill. Commercial product is Resyn 3600, an aqueous dispersion of the copolymer.

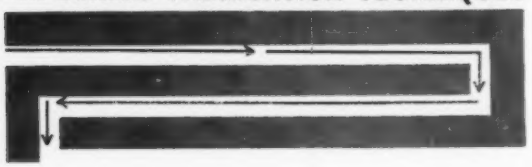
Action Plastics, Inc., a subsidiary of Colorite Plastics of New Jersey, has acquired another building next to its present plant in Paterson. Both the subsidiary and the parent company are extruder firms.

Monsanto Chemical Co. has begun the erection of a multi-product chemical plant on a 650-acre tract in Gloucester County, N. J. Among the products to be manufactured are benzyl chloride and Santicizer 160, a vinyl plasticizer.

Fabri-Kal Corp. is building a 23,000 square foot plant in Kalamazoo, Mich. The firm forms plastic sheet.

Nopco Chemical Co. is erecting a polyether urethane foam plant in Chattanooga, Tenn. Estimated capacity is 4-million pounds per year.

PLASTICS TECHNOLOGY
EXPLORING FABRICATION TECHNIQUES



By L. J. ZUKOR, *ENGINEERING EDITOR*

Saving Labor in Plastics Processing

Want to save yourself some time and money?

Plastics processing, like any other recently developed technology, has seen its share of Rube Goldberg devices (jigs and fixtures) developed by the thinking processor to facilitate specific job operations. Only in the last few years has auxiliary equipment design begun to catch up with basic machine designs in terms of applied engineering principles. Here are a couple of examples of what has been done to increase plant efficiency by eliminating certain hand labor operations.

Specialized Machines

Vacuum-forming, like other industries, uses both specialized and general purpose machines. The latter can be adjusted mechanically or fitted with interchangeable tools which ease change-over for different product runs. Specialized machines are primarily made to handle specific sizes or types of products. Most auxiliary machines belong in the latter category.

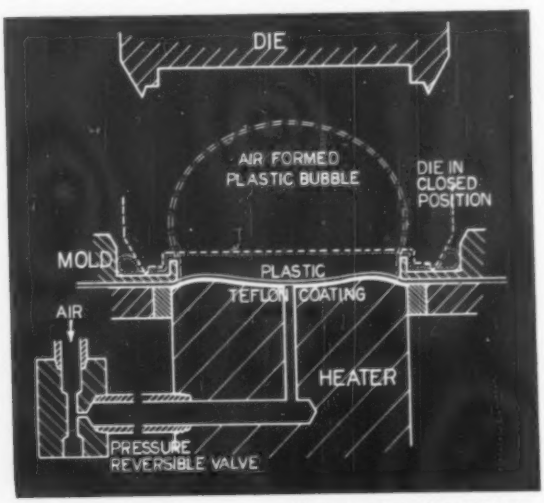
Photo courtesy: Plast-O-Craft Inc.

Grommet-forming table top machine.

Bill Budzyn, chief engineer of Plast-O-Craft Inc., Newark, N. J., recently pointed out for me some of his latest designs. Of special interest was a semi-automatic unit which self-grommets thermoplastic sheet. This machine was designed for 5-15 mil polyethylene sheet, but adapts readily to other thermoplastics which do not have sharply defined melt points.

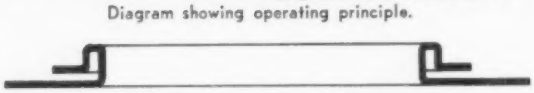
The machine performs multiple operations in sequence, namely conduction heating, blowing, forming, and shearing. The sheet is positioned on the table, and a mold is centered over the portion to be heated. A "pressure-reversible" valve (venturi) draws a vacuum, using a fixed flow of air. This holds the sheet in close contact with the heat source, insures uniform heating, and prevents warpage. Increasing the air velocity increases the negative pressure or vacuum. A pressure-reducing valve controls both vacuum and blowing pressure. The latter is determined by the thickness of the sheet being formed, and is somewhere between 2 and 18 psi., for 5-15 mil sheet.

When the sheet reaches a predetermined degree of softness, the outlet of the "pressure-reversible" valve is closed. This changes the direction of air flow into the previously evacuated passage. As the bubble is forming, the die (mounted on a double acting cylinder) is brought down, flatting the bubble and shearing the double thickness of material formed by the die and



Diagrams courtesy: Plast-O-Craft I...

Diagram showing operating principle.



Cross-sectioned view of finished grommet.

mold. Retracting the cylinder and snapping the mold loose gives the grommet its final shape and removes sheared scrap. Production varies between two and four parts per minute, depending on the thickness of material and configuration of formed part.

Hopper Loaders

These are necessary auxiliary equipment in both large and small installations. For granular thermoplastic materials, the most efficient type includes a closed air conveyor system to avoid dusting and contamination. This is still a problem in shops employing manual loading. Other reasons for choosing air rather than mechanical means for conveying plastic materials are economy of original equipment, lower power requirements, and ease of maintenance.

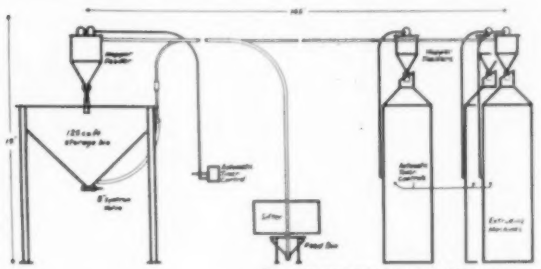


Diagram courtesy: Unichem Products, Inc.

Schematic showing hopper loading system.

Air conveying units are sized to needs, depending on the size of the operation. Draco and Fuller systems are two of the most economical units for moving large quantities of plastic granules from storage to the hoppers of 100 or more machines. However, these same systems are uneconomical when scaled down to fit smaller operations. You don't need a battery of 100 machines to require a similar-type device, except that your loading will be from drums located on the floor rather than from large storage bins.

Compressed air passing through a venturi operates the individual hopper loaders, creating negative pressure behind the venturi throat. This draws granules out of the drum. When they pass beyond the venturi throat, air pressure adds velocity to the pellets, lifting them up to the machine hopper as in the Whitlock unit. This single venturi unit is limited in the distance that it will carry material weighing over 25-30 lbs./cu.ft.

Another venturi system is the Vac-U-Max-type. Here, the venturi is affixed onto an auxiliary hopper, pulling a vacuum through the granule-conveyor tubing. Velocity is regulated by opening or closing a sleeve valve located at the "suction-wand." This system permits movement of heavier material for greater distances than does the simple system. Placing multiple venturies on the auxiliary hopper, whose discharge opening is closed with a Syntron-type seal, accomplishes this.

This extended system has been installed at Unichem Products, Inc., Division of Colorite Plastics of N. J. It is used to transfer vinyl granules from the pelletizer set-up to storage and from there to the auxiliary hoppers situated over the extruder hoppers. The 50 lb./cu.ft. density pellets are picked up at a rate

Photo courtesy: Unichem Products, Inc.

Plant layout showing vinyl processing and storage area.

of 3,000 lbs. per hour from a two cubic-foot feed bin and conveyed to a four cubic-foot, time-controlled, auxiliary hopper. The cycle is one minute "on", and ½ minute "off." The automatic discharge valve at the auxiliary hopper throat permits gravity feed to a 125 cubic-foot storage bin.

This material can be fed through the spout at the base of the bin to an automatic bagging machine or fed to Unichem's three extruders located 92 feet, 110 feet, and 145 feet away by means of three separate connections located on the slope of the feed bin. Aluminum tubing carries the pellets to the individual auxiliary hoppers located over their respective extruder hoppers. Pellets are released on a timed cycle set to deliver at a rate of 400 lbs. per hour.

Pneumatic conveying has one draw-back—the transfer of dry-blended materials. When the bulk density of a pigment approximates the bulk density of the resin, the materials have a reduced tendency to separate. When this occurs, the only factor that would control separation would be air velocity. Separation occurs when material densities in a mixture differ widely.

Photo courtesy: General Electric Co.

Shown at the right is a filter, pressure gage, and reducer feeding air to a Whitlock venturi used for conveying Lexan polycarbonate pellets. In this photo the dip-tube has been removed from the venturi.

Names in the News

Adolph Monsaroff

The following have been elected officers of the Society of the Plastics Industry (Canada), Inc.: **Adolf Monsaroff,** executive vice president of Monsanto Canada, Ltd., president; **E. G. Salmond,** Canadian Plastics, vice president; and **J. Z. Macpherson,** Canadian General Electric Co., Ltd., treasurer. Members of the Executive Council include: **A. A. Allan,** Carbide Chemicals Co.; **W. S. Wood,** F. F. Barber Machinery Co.; and **R. F. Harrison,** immedate past president.

Norman A. Klemp has joined Pacific Moulded Products Co. as plant manager. He was previously assistant to the president of Sheller Mfg. Corp. At the same time, **Robert S. Lundgren** joined Pacific as chief engineer. He has served in executive engineering positions at three companies, including mechanical goods division, General Tire & Rubber Co.

Andrew A. Dukert

Andrew A. Dukert, who has had 25 years' experience in the plastics field, was appointed plastics development engineer at the research products development department of Pennsalt Chemicals Corp. He will concentrate on the commercial applications of such plastics as Pennsalt's new polyvinylidene fluoride resin, RC-2525.

J. B. Bronson has joined Allied Chemical Corp. as assistant to the sales director, plastics and coal chemicals division. Prior to his appointment, he was manager of central industrial relations at Food Machinery & Chemical Corp.

Milton A. Connor has retired as vice president of Allied Chemical's National Aniline division after 42 years of service with the company. After holding various production and managerial positions, he was appointed vice president-manufacturing facilities in 1951.

Rexall Drug and Chemical Co. has organized a national film division. The following have been appointed to man the division: **Horton Conrad,** national general manager; **Jack De Caprio,** national general sales manager; **Joseph H. Gauss,** sales manager, national accounts; and **Henry C. Clark,** manager of engineering and production costs control. Messrs. Conrad and De Caprio previously were sales directors of, respectively, Gering Plastics, division of Studebaker-Packard Corp., and Cryovac division of W. R. Grace & Co. Mr. Gauss had been general manager for sales and manufacturing at Paramount Packaging Co., and Mr. Clark, extrusion engineer for Tupper Co.

Santa Ana Film, division of Rexall Drug and Chemical, has announced the appointments of **George G. March,** plant manager, and **Charles A. Blackburn, Jr.,** and **William H. West,** sales representatives. **Charles Farrell** is general manager.

John L. Cook has recently been named a mid-west manager for Hull Corp. He comes to the position after two years in the plastics department of Western Electric Corp.

A. W. Schubert was elected president of Emery Industries, Inc., succeeding **John J. Emery,** now chairman of the board. Mr. Schubert was previously executive vice president. He has served in various executive positions since joining Emery in 1924 as a cost accountant. Mr. Emery had served as president since 1925.

Earl W. Lane has joined Escambia Chemical Corp. as manager, new product development, commercial development department. He will have headquarters in New York.

Two executives at Spencer Chemical Co. have assumed new duties. **Frank Pyle,** formerly vice president-plastics, is now vice president and assistant to the president; **Harold Dinges** has been switched from vice president-industrial chemicals to vice president-plastics, with responsibility of plastics sales and related activities.

S. W. Corbin has been named general manager of industrial sales operation at General Electric Co.

Herbert O. Corbett has been appointed chief extrusion technologist for Kordite Co. Formerly group supervisor in research and development, he will now be responsible for invention, development, and consultation in plastics extrusion. He has been with the company in development-engineering programs for the past four years.

T. J. Kinsella, president of Allied Chemical's plastics and coal chemicals division, has been appointed general manager of the commercial development department. Dr. Kinsella, with Allied since 1947, has been working for the last few months on special studies related to corporate planning.

Richard H. Haas

Richard H. Haas, new manager of plastic sales for Goodyear Aircraft Corp., is responsible for military and commercial plastics sales. A patent attorney, he has worked with Union Carbide and Carbon Corp., Krafco Container Co., and most recently, Continental Can Co. After four years with the last, he joined GAC last December.

R. B. Huey and **W. R. King** have been appointed sales engineers in the home office of Goodyear Tire & Rubber Co.'s chemical division. Mr. Huey will be concerned with Vitel polyesters for textiles and Mr. King with coatings.

OBITUARY

Donald F. Fraser

Donald F. Fraser, vice president-manufacturing of Garlock Inc., Palmyra, N. Y., died of a heart attack on Monday, September 12, in Clifton Forge, Va.

Mr. Fraser, 47, joined Garlock on February 1, 1954 and served successively as acting chief engineer, works manager, and production manager. His duties as vice president-manufacturing, to which position he was elected in 1957, included supervision of all production facilities at Palmyra and five subsidiary plants. Before joining Garlock, he had been vice president and general manager of Rodic Chemical and Rubber Corp.

A native of Toronto, he held a B.A. Sc. from the University of Toronto. He was a director of the New York Rubber Group and a member of ACS and ASME.

New Materials

For more information check Readers' Service Card (p. 87)

Polyethylene Formulations

Eastman Chemical Products, Inc., has developed formulations of polyethylene for weather-resistant extrusions and for paper-coating extrusions. The stabilized Tenite polyethylene is claimed to be the first for film use containing a non-pigmented ultraviolet inhibitor. Five-mil film retained a high degree of clarity, smoothness, pliability, and toughness after 24 months' exposure, says the company. These characteristics are expected to increase the use of polyethylene in outdoor applications. Eastman will also supply a stabilized formulation for injection molding of heavier sections and extrusion of sheet 50 mils or greater.

Tenite polyethylene 895 for coating paper and other substrates is also now available. The material is claimed to have excellent adhesion to kraft and other papers, porous and non-porous. The company says it will produce coatings free of pinholes at rates of 7½ pounds per ream (about 0.5 mil). Neck-in is moderate and there is no edge variation. Minimum sealing temperature is about 270° F. Other characteristics:

Melt index	3.5
Density, g./ml	0.921
Softening point, Vicat, °C.	95
Brittleness temperature, °C.	−60
Tensile strength, psi., upper yield	1,500
Fracture	1,700
Elongation, %	500
Stiffness in flexure, psi	18,000
Dielectric constant, 100 kc.	2.3
Dissipation factor, 100 kc.	<0.0005

Readers' Service Item 1

High-Density Polyethylene

Properties and specifications of its high density polyethylene, reported to combine improved durability with processability, have been announced by Goodrich-Gulf Chemicals, Inc. The material is claimed to have reached new highs in environmental stress cracking resistance and in temperature embrittlement resistance.

According to the company, the polyethylene can be depended upon to behave predictably in compression molding, extrusion, blow molding, injection molding, and wherever flow is important. It is recommended especially for blow-molded containers, wire and cable insulation, and extruded pipe.

Three grades of Ameripol 0.95 density polyethylene will be produced initially.

	Ameripol Grade No.		
	32	34	36
Molecular weight	50,000	80,000	100,000
Melt index, g./10 min.	0.1–0.2	0.04–0.08	0.001
Flow index, g./10 min.	24–28	8.5–9.3	4.0–5.6
Intrinsic viscosity	2.3–3.0	3.1–3.7	3.8–4.8
Vicat softening temperature, °C.	119	121	122
Ultimate tensile strength, 20 ipm., psi	2,250	2,450	2,700
Tensile at yield, 20 ipm., psi	3,450	3,450	3,450
Impact strength, ft. lbs./in. notch			
¼ x ½ bar	19	31	36
¼ x ½ bar	8	17	24
Stiffness in flexure, psi.	115,000	115,000	120,000
Hardness, Shore D	60	60	60
Environmental stress cracking, hrs.			
With antioxidant	65	445	>800
Without antioxidant	40	230	500
Thermal embrittlement, hrs.			
With antioxidant	185	>1,000	>1,000
Without antioxidant	70	95	700
Dielectric strength, 25° C., volts/mil	1,100	1,100	1,100
Dielectric constant, 25° C.,			
60 cps.	1.82	1.82	1.82
10,000 cps.	2.26	2.26	2.26
1.0 mc.	2.38	2.38	2.38
Dissipation factor,			
25° C., 60 cps.	0.00017	0.00017	0.00017
10,000 cps.	0.00023	0.00023	0.00023
1.0 mc.	0.00034	0.00034	0.00034
Volume resistivity, ohm-cms.	7×10^{13}	7×10^{13}	7×10^{14}
Insulation resistance, ohms/1,000 ft.	164,000	67,500	118,000

Readers' Service Item 2

Specialty Vinyl Dispersion

A specialty vinyl dispersion resin for compounding plastisol and organosol formulations for a variety of end uses has been introduced by the chemical division of Goodyear Tire & Rubber Co. Pliovic WO is claimed to impart desirable flow and gelation characteristics to compounds for knife, roller, and dip coating, plastisol gasketing, and roto-cast and slush molding. Potential uses include fabric coatings, adhesives, gasketing, toys, and specialty molded products.

Products molded from Pliovic WO exhibit excellent ultraviolet, abrasion, chemical, and water resistance, as well as good flex life. Further, it is claimed that adhesion to many surfaces, good heat and light stability, and improved electrical properties are also possible through the use of this resin.

Typical Pliovic WO properties are:

Vinyl chloride content, %	100
Inherent viscosity	1.10
Specific gravity	1.40
Bulk density, lb./cu. ft.	31
Particle size, avg., microns	1–2

Readers' Service Item 3

Monomer-Free Polyester Resins

Three monomer-free polyester resins, which can be dissolved in any desired monomer, have been made available by Commercial Resins Corp. Two of the resins, CoRezyns 1 and 2, are solid. CoRezyn 1 is a rigid orthophthalic polyester and CoRezyn 2, a resilient isophthalic polyester. The third resin, CoRezyn 3, is a flexible, viscous liquid. Still another new resin, isophthalic laminating CoRezyn 309, has been announced recently.

CoRezyn 1, 65 parts dissolved in 35 parts of styrene monomer, gives a resin of about 400 cps. viscosity. CoRezyn 2 in an equal weight of styrene gives a material with viscosity of 350-400 cps. CoRezyn 3, two parts by weight in one part of styrene, yields a resin of 450 cps. viscosity. Physical properties of these resins, in the given dilutions, are the same, respectively, as those of CoRezyns 110, 301, and 140.

The fourth new resin, CoRezyn 309, is recommended for building molds and general purpose hand lay-up. It is a promoted resin which requires a benzoyl peroxide catalyst. In its liquid state, it has a specific gravity of 1.045. Heat distortion temperature of the cured resin is 95° C. Barcol hardness is 40-42.

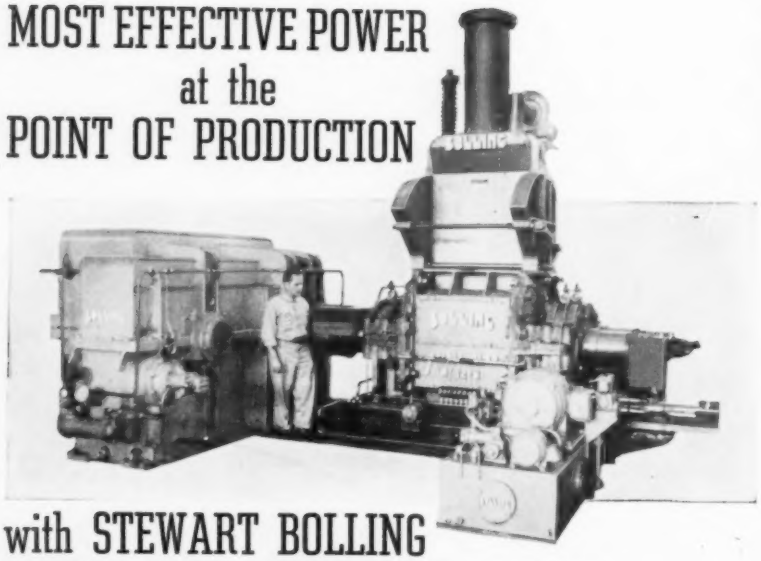
Readers' Service Item 4

Thermoset Resin Removers

Metachem Resins Corp. has made available two compounds for cleaning up epoxy, polyester, and similar compounds. One, Meta-Strip 702 liquid and gel can be used for cured compounds; the other, Metaterge 1405, will dissolve uncured resins.

Since Meta-Strip 702 is non-corrosive and does not contain acid and alkali, it can be used to recover plated electronic parts or components. Since it is an extremely powerful solvent, it may also dissolve wire coverings and other insulation. The liquid is used for immersion, the gel for parts too large for immersion. Flash point of the liquid is 67° C.; of the gel, 68° C. Ignition temperatures, in the same order, are 440 and 445° C.

MOST EFFECTIVE POWER
at the
POINT OF PRODUCTION



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Metaterge 1405 was developed to meet the need for a non-flammable cleaner of minimal toxicity. It converts waste resins into a completely water dispersible state. Flash point is 190° F.; ignition temperature, 290° F.

Readers' Service Item 5

Insulating Material

An insulating material reportedly combining the electrical and mechanical properties of vulcanized fiber with the low moisture absorption of phenolic laminates has been announced by National Vulcanized Fibre Co.

Known as Anilite, the insulator may be used in circuit breaker and transformer barriers, knife switch guides, wiring devices, etc. It can be punched and machined for finishing, and can be drawn or formed into permanent shapes.

Readers' Service Item 6

Also Worth Mentioning—

☐ Laminates for different purposes are constantly being developed and improved. Two from Taylor Fibre Co. are G-3, a woven glass fabric-phenolic laminate, and C-7, a cotton-phenolic. The former is suggested for use in armature slot wedges and liners, and where good electrical properties at temperatures up to 325° F. are required. Post-forming grade C-7 is made to permit draw and stretch to take place in forming. When it is burned, it will not continue to glow after the flame is extinguished.

Readers' Service Item 7

☐ A paper-base phenolic laminate which provides flame retardance with cold punching characteristics has been announced by National Vulcanized Fibre Co. In its two copper clad forms, it is applicable in radio and television and in electronic computer printed circuits. The laminate is claimed to serve as well as the much more expensive epoxy-paper laminates.

Readers' Service Item 8

☐ Borden Chemical Co. has developed a high speed vinyl resin-based lap end paste for can labeling operations. Designed for use on a wide range of label stock, including varnished and coated grades, the adhesive is designated Cascorez CV-704. It is claimed to offer good coverage, low viscosity, high moisture resistance, high solids content, and fast setting. It dries clear.

Readers' Service Item 9

New Equipment

For more information check Readers' Service Card (p. 87)

Clear-Pak manual blister sealing unit

Blister Sealing Machines

Erdco Engineering Corp. has announced the availability of a manually operated blister sealing machine and a high speed, large package sealing machine.

Clear-Pak manual will seal a blister approximately six by eight inches and up to three inches high in six seconds. The machine, designated Model 04CP, will fit in a bench area 18 by 25 inches.

Model 05CP, Clear-Pak Jr., will seal blisters as large as ten by 13 by three inches high on its 28-inch table. Like the smaller model 04CP, it can be adapted to package items up to ten inches in height. It will seal packages in only three seconds. The model measures 28 by 36 by 21.

Plywood dies can be made for the sealers in the user's factory. The only power requirement is 110 bolts, 60 cycles, and a small amount of compressed air. Both models come equipped with air pressure regulator and controls.

Readers' Service Item 21

Portable Heat Sealer

Weldotron Model 8T portable thermal impulse sealer.

Weldotron Corp. has introduced a portable thermal impulse sealer which will make seals up to eight inches long and ⅛ inch wide. A separate power pack is used to give impulse to heating tape on hand operated sealing tongs.

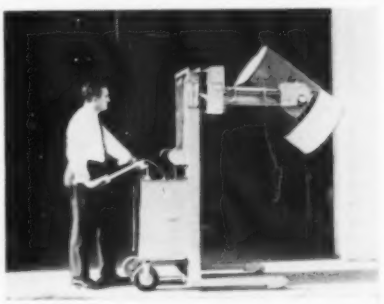
The unit is recommended for application where larger, stationary units are ineffective. It will seal two sheets of 6-mil polyethylene or two sheets of 3½-mil PVC in, for example, large drum liners and bags.

Tongs weigh 1.76 pounds. Input power: 110 volt, 60 cycle; power consumption during impulse: 400 watts.

Readers' Service Item 22

Portable Drum Dumper

Four models of the Tubar portable Dump King drum dumper, in different stages of automation, have been put on the market by Tubar dumper division,

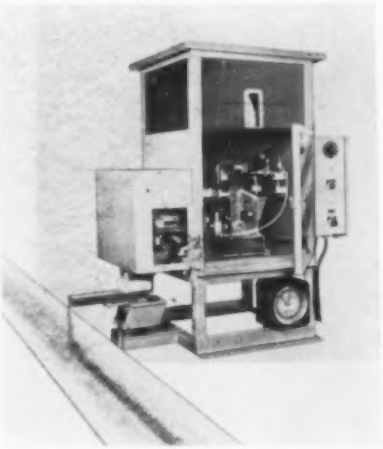


Tubar Dump King.

Uhrden, Inc. The dumper may be completely powered for grabbing, lifting, dumping, and travel, or may require manual operation as well. Models will handle drums with capacities up to 750 pounds.

The standard frame for all models has an overall height of 76 inches and a 66-inch maximum lift at the dumping pivot. Additional dumping heights in unit elevations of 12, 24, 36, and 48 inches can be provided. Hydraulic or manual grab holds the drum in vertical or horizontal position. Hydraulic grab opens to 23½ inches at entry, 25½ inches at center, and close to 15½ inches at center for small drums. Manual grab is crew type with hand crank. Dump King has grab pads ½-inch thick, and can be furnished with a crush proof carriage for fiber drums.

Readers' Service Item 23



Exact Weight continuous weigher.

Continuous Weighing Machine

A machine for the continuous weighing of loose, free flowing, granular solids has been made available by Exact Weight Scale Co. It will insert dry additives into processing lines operating by conveyor, pipeline, or other continuous flow method. The unit is preset to release the optimum weight of additive into the flow at equal intervals. A scale weighs precise amounts of material in a net weigh hopper. An air operated mechanism dumps the additive into a secondary hopper which, in turn, feeds a vibratory feeder.

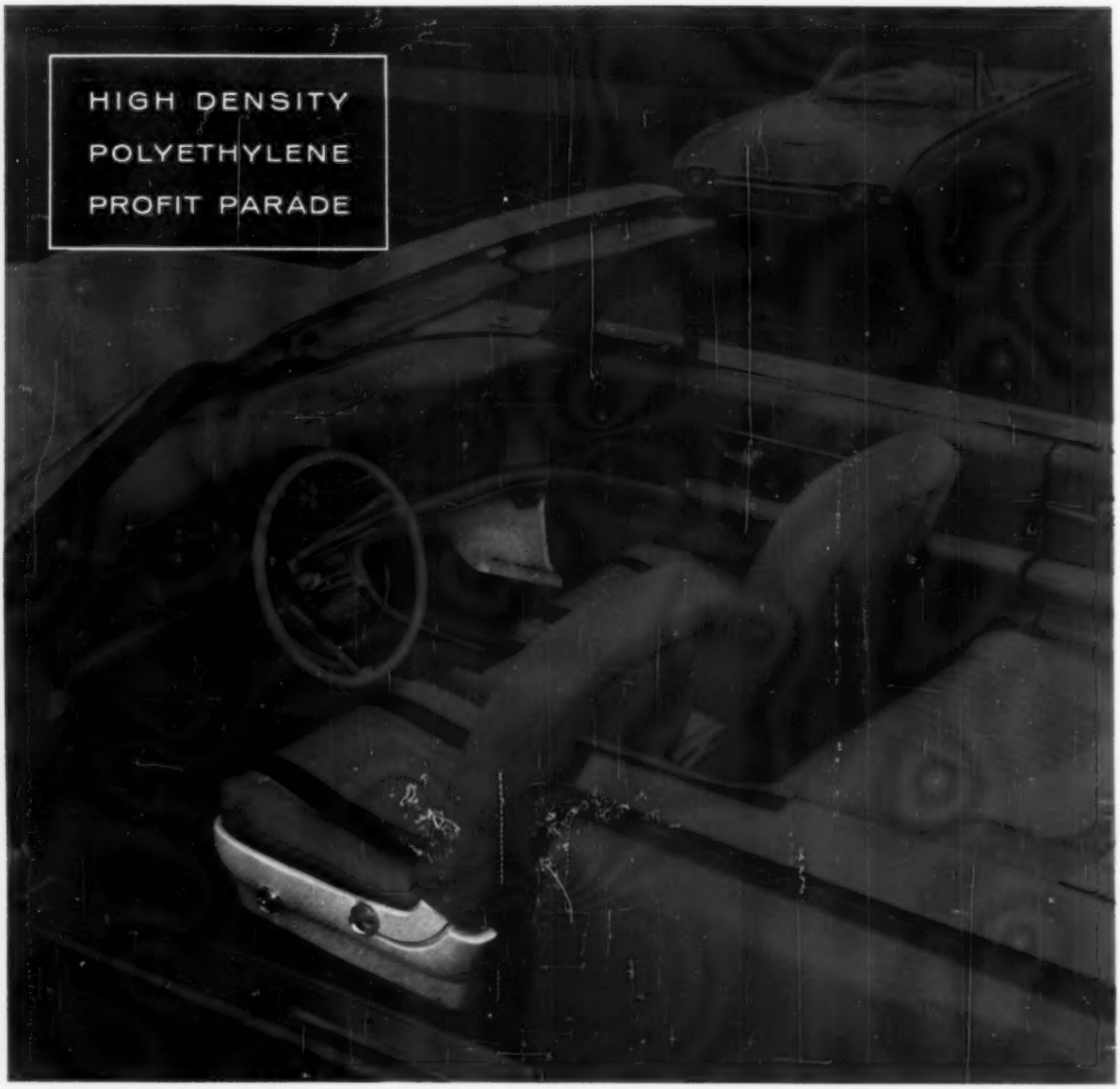
The machine will weigh quantities from one ounce to ten pounds. Hoppers and feeders are available in several capacities. Multiple units can be used to increase the number of weighings per minute without sacrificing accuracy.

Readers' Service Item 24

Propeller-Type Mixers

A line of Lightnin propeller-type portable mixers for fluid agitation in process industries has been announced by Mixing Equipment Co., Inc. It is marketed in sizes from ⅛ hp. to three hp., in direct drive speeds of 1,750 rpm. and 1,150 rpm., and in a gear drive speed of 350 rpm. Gear drive models are quiet running, leak proof, and equipped with single reduction, internal helical gears. Both direct and gear-drive models rotate clockwise.

The series features a positive drive chuck which permits accurate coupling in one operation. It is always located above the maximum fluid level of the tank. The



Grace Plastic Adds to Lasting Value of Classic Car

The beautiful, classic Thunderbird is a king in Ford Motor Company's famous line. And as befits a king, all its parts and appointments are made with special care, for lasting beauty, value and service . . . while maintaining realistic economies.

Example: Grex High Density Polyethylene is a material used in three "show" parts of this '61 model—in the side cowl cover, the side seat shield, and the pivot cap on the seats. Besides having smooth beauty, these parts also must be scuffproof. And they must be perfectly color-matched with other parts of the interior.

Grex is an excellent material for components such as these, where beauty, duty and economy of fabrication must go hand in hand. Grex can be formed by any conventional fabricating technique, in any color. It takes day-after-day punishment without chipping, cracking or breaking. It can undergo extremes of temperature without losing its strength or shape. And most important of all, it adds beauty and value to this car.

If you need the special advantages of high density polyethylene, don't overlook the experts. Grace has the production facilities, technical service and experience to help with demanding components problems. And we're easy to do business with.

Grex is the trademark for W. R. Grace & Co.'s Polyolefins

W.R. GRACE & CO.
POLYMER CHEMICALS DIVISION

CLIFTON, NEW JERSEY

'61 Thunderbird sets
a standard for value.

Color is critical. As every auto buyer knows, cars are made in almost every color of the spectrum. Ford, in its Thunderbird line alone, uses 6 colors. Grex already has been supplied in all of these approved colors.

Matching colors to the most critical standards requires ingenuity, patience and experience. For colors must not only pass stringent visual tests under the Macbeth light, but must stand the test of time as well.

Wearing qualities essential. There would be little virtue to parts made of Grex if they merely appealed to the eye. All the parts are in "wear" locations, and are subject to scuffing or continual flexing. The problem of scuffing is overcome with a handsome, textured, leather-like effect. Scuffs literally "bounce off." This textured pattern was engraved in the irregular surface molds by photo arc.

The side cowl cover presented a special problem. It is thin-gauge, yet has large surface area. High density polyethylene was selected as the material for this part because it resists abrasion, withstands flexing, and has native toughness, even in very thin, large-area sections.

Why not use some other material? High density polyethylene has special advantages in applications like these. It requires no additional surface finish, and gives close color match. It has a warmth and solidity lacking in other materials. It doesn't chip, crack, or peel. Perhaps most important, it maintains economies while actually improving the quality look of components.

What about you? The problems present in this application can be applied profitably in other products. Luggage, for instance. And housewares, appliance components, quality toys. If you'd like a profitable answer to a high density polyethylene question, just write us:

Technical Service Department
Polymer Chemicals Division
W. R. Grace & Co., Clifton, N. J.

Lightnin stationary (left) and portable mixers.

portable mixer can be adjusted 90° in the vertical plane and 360° in the horizontal plane. A position-indexing device pinpoints the mixer's optimum position and facilitates repositioning. Lifting eyes and a positioning handle are required to mount or remove portable units.

Fixed mounting mixers are built for open and closed tank installations. The closed tank series mounts on standard IPS mounting flanges and can be furnished with stuffing box or rotary mechanical seal. The fixed mounting series is the same as the portable, except that it is not available in the ⅛ hp. size. The portable series is ND-4B; the fixed mounting, N33G-300.

Readers' Service Item 25

Lathe Collet Chuck

Jacobs Manufacturing Co. has designed a lathe collet chuck to replace chucks using split steel collets. Model 50 chuck reportedly requires only ten Rubber-Flex collets to do the work of 61 split steel collets. The chuck has a one-piece, high-impact handwheel of General Electric phenolic with a steel insert.

Readers' Service Item 26

Injection Blow Molder

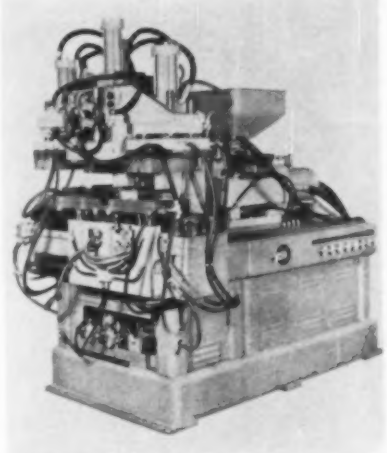
Moslo Machinery Co. has developed a self-contained injection blow molding machine for the mass production of plastic bottles, jars, toys, and other products with irregular shapes.

Parisons are injection molded on a core rod, and then shifted into a blowing station and blown to final size and shape. Secondary operations such as reaming and trimming are eliminated. In injection blow molding of bottles, stresses are minimized, and pinch-off is eliminated. Sections throughout bottles are more uniform than those produced by extrusion. Further, since pinch-off is not a problem, it is easier to mold bottles with large necks.

Among the features of Model 1246 Duplimatic blow molder is a separate operator console reportedly using the largest printed circuit board of its kind. The machine incorporates a basic hydraulic injection system and utilizes a multiple mold arrangement of two blow mold and blow ejector stations plus one central parison mold station. Parison holders will accommodate one to six spindles, depending upon the weight and shape of the items to be produced and the design of the molds.

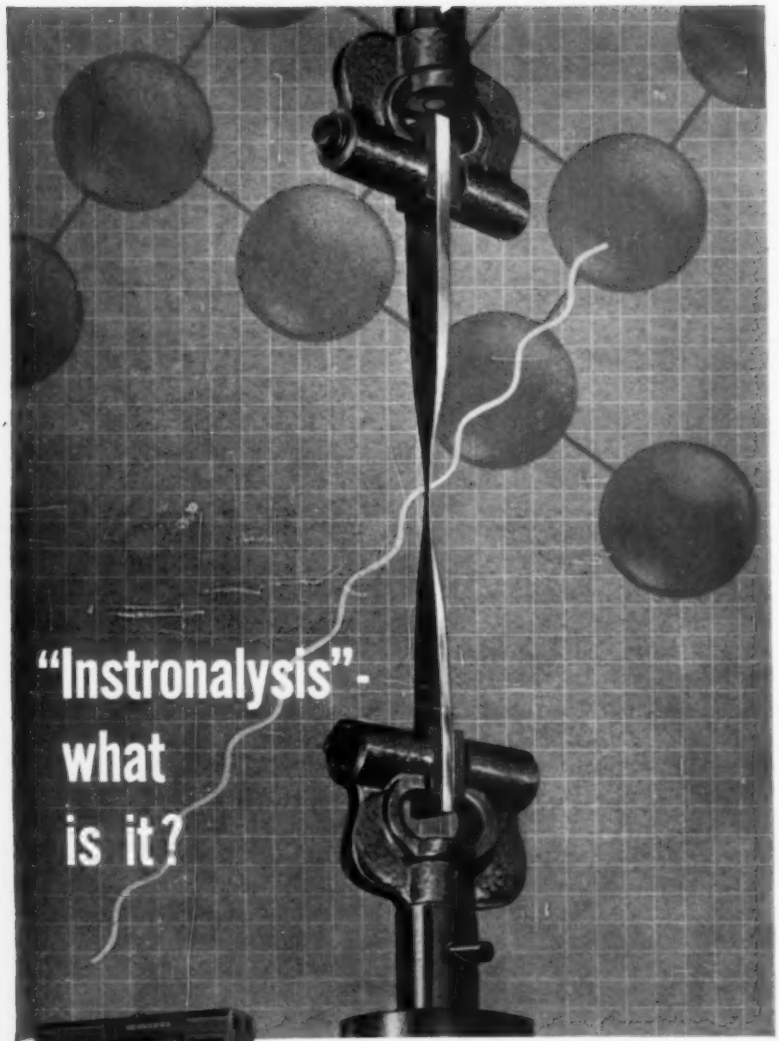
Specifications of Model 1246 include:

Injection capacity/shot, ounces	4–6
Cycles/hr., dry run	625
Rate of injection, with & without booster, cips	9.36–2.62
Diameter and stroke of injection ram, in.	2 x 8
Maximum psi. on material	20,000
Plasticizing capacity of press, lbs., minimum	125
Parison mold size, top and bottom, inches	10 x 11½
Thick	5
Blow mold size, inches, top and bottom	10⅜ x 14
Thick	5
Mold opening, inches	5
Mold locking force, calculated, tons	90
Parison shifting stroke, inches	17
Maximum mold casting area, sq. in.	40
Capacity of material hopper, lbs.	75
Injection cylinder heaters, watts	11,000
Multiple nozzle manifold heaters, watts	2,000
Operating temperature of material cylinder, °F	150–650

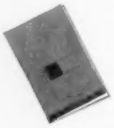


Model 1246 Duplimatic blow molding machine.

Readers' Service Item 27



The Instron comes in various models and sizes, to suit the widest applications — for tests under all sorts of environmental conditions. ILLUSTRATED: **FLOOR MODEL**—load ranges from 2 grams to 10,000 lbs.



Interesting studies on the rheological properties of viscoelastic materials are available in Bulletin PC-2 and R-3. Reprints on many other fields of testing are also available for the asking.

"Instronalysis" means in-depth testing of materials with the Instron Universal Tester. You won't find the word in Webster's, but it is a term of importance to every laboratory concerned with modern testing techniques.

That's because today's technology demands nothing less than in-depth testing. Stress-strain curves alone are no longer adequate to measure the characteristics of long-chain molecular materials and other new "miracle" products. Today's tester must be able to determine the effect of different strain rates at various temperatures, energy loss under repeated cycling, stress relaxation and recovery, recoverable and unrecoverable creep, and many more characteristics beyond the scope of conventional equipment.

"Instronalysis" brings together both routine and advanced testing techniques within easy reach of a single instrument. It's what we mean when we say "You can do more with an Instron."

INSTRON
ENGINEERING CORPORATION
2501 Washington Street, Canton, Mass.

Walk-In Environmental Rooms

Labline, Inc., has announced a line of walk-in environmental rooms with two temperature ranges up to 140° F. They measure 6 by 6, 6 by 8, 6 by 10, and 6 by 12 feet. Inside working height is 7 feet.

All models have fully enclosed heating elements. The plenum chamber construction has eliminated all interior ducts and louvres. Rooms have a 12 by 12 inch Thermo-Pane viewing window.

Cooling below room temperature is provided by a hermetically sealed, air cooled compressor using Freon gas. It is mounted on top of the cabinet.

Lab rooms are suited for the preservation and storage of samples, for aging tests, specific gravity determination, chromatography, etc.

Readers' Service Item 28

Also Worth Mentioning—

☐ Buckeye Tools Corp. has expanded its line of air-powered portable saws to include 8¼ and 12 inch models. The former weighs 18 pounds and is rated at 2¼ inch depth of cut, while the 12-inch model weighs 22 pounds and has a 4¼ inch depth of cut. Depth of cut is adjustable from these maximums. The saws are available in operating speeds of 3,000, 4,800, and 6,000 rpm.

Readers' Service Item 29

☐ Harco Laboratories, Inc., offers a complete line of metal sheathed thermocouples designed for rapid, accurate, economical temperature sensing applications.

Readers' Service Item 30

☐ A conveyor system that moves material at speeds of up to 2,000 feet per minute on a cushion of air is being marketed by Engineers Associated. The system, Jetstream, is claimed to have a level load capacity of up to 30 pounds per square foot and to operate at inclines to 45°. Operation is achieved by metering low-pressure air through special louvers which direct an air flow along the carrying surface of the conveyor.

Readers' Service Item 31

☐ The O-Vee screw thread measuring used with a standard hand micrometer will determine the size of a screw thread and whether it is within tolerance. Consisting of a coil spring mounted on a data plate, the gage is available in standard sizes from #5 to one inch, in all series and all classes of fit. It is available from Scherr-Tumico, who claims the gage will provide precision measurement and speedy operation at low cost.

Readers' Service Item 32

Plastics Applications

For more information check Readers' Service Card (p. 87)

Thermax longitudinally-seamed pipe insulation.

Urethane Foam Pipe Insulation

An all purpose industrial pipe insulation called Thermax, designed to insulate any pipe from —300° F. to 275° F., is being manufactured by American Cellular Co. Inc. Fabricated of urethane foam, Thermax is constructed with a longitudinal seam which allows it to spread open to receive the pipe and, upon release, to snap quickly into the designated position.

Due to its low K factor and longevity, Thermax is recommended for industrial cold processing plants and commercial and institutional refrigeration systems where sub-zero conditions are the rule. It can also be used in smaller size hot water or low pressure steam lines operating at temperatures up to 250° F. and, when covered with a factory-applied moisture vapor barrier jacket, meets the requirements of dual temperature service.

Thermax is manufactured from a foam system supplied by Isocyanate Products, Inc., from basic chemicals supplied by Mobay Chemical Co.

Readers' Service Item 41

Sturdy Recording Tape

Scotch No. 311 magnetic tape, featuring a new backing material called Tenzar, has been developed by Minnesota Mining and Manufacturing Co. for use under recording and playback conditions involving frequent repeat, continuous play, and constant handling. It is characterized by tear-, stretch-, and moisture-resistance.

Tear strength (measurement of the force required to tear the tape after the edge is nicked) is claimed to be 16 times greater than that of acetate-backed tape and twice as great as that of polyester-backed tape. The Tenzar tape tends to resist nicking, claims the company, but even if nicked, will remain intact. Tenzar is on a par with polyester in long term storage, but polyester's tensile strength is slightly greater.

High potency oxide has been applied uniformly to the tape for full-range frequency response. The coating is impregnated with silicone lubrication to assure smooth travel past recording heads.

Readers' Service Item 42

Miniature Radio

A compact, transistor radio, equipped with an adjustable wire loop which hooks over either left or right ear, has been developed by Micro-Ceiver, Inc. Measuring 1¾ inches high, 2¼ inches wide, and 2 inches long, and weighing less than an ounce, the unit will receive four to six stations within a 15-mile radius. It will play at the sound level of a whisper or loud enough to be heard by many persons.

The radio is encased in Celanese Forticel cellulose acetate. The case, molded by Crown Plastics, comes in red, blue, and tan.

Micro-Ceiver transistor radio.

Micro-Ceiver runs on two one-inch batteries which have an estimated playing time of 100 hours.

Readers' Service Item 43

Woodgrained Plastic Trim

Silvatrim Mouldings, division of Glass Laboratories, Inc., has announced the manufacture of woodgrain-finished plastic trim moldings in over 150 stock cross sections. The moldings are also available with marble, speckled, and glitter patterns to match the finish of high pressure laminates. Special effects combining a metal finish with a pattern can also be produced.

Its flexibility allows Silvatrim to be hand formed, bent around sharp corners, and curved, in many cases without mitering.

Readers' Service Item 44

The Power of Polyethylene

The use of plastics in rifle and pistol handles is now being complemented by the application of linear polyethylene for bullets. High density polyethylene produced by Dow Chemical Co. is being injection molded by Saxe Brothers, Inc., into revolver cartridges for Colt's Patent Fire Arms Manufacturing Co., Inc. This was reported to be the first application of Dow's material.

According to Saxe, R800 polyethylene provides the necessary rigidity and toughness to allow the cartridge to retain its shape under load shock.

The cartridge, loader with wax bullet and powered with a primer only, is designed for training and practice. Heaviest use is expected to come from police departments, where the wax-loaded ammunition can be used in training rookies to shoot.

The cartridges are produced in .38 and .45 calibers.

Readers' Service Item 45

Translucent Building Panel

A translucent fiberglass and nylon-reinforced plastic building panel is claimed, by Filon Plastics Corp., to show substantially greater resistance to weather, chemicals, abrasion, erosion, and moisture than comparable materials. The panels are guaranteed structurally for the lifetime of the installation. Surface, color, and light transmitting properties should be retained under normal conditions for 15 years.

Known as Filoplate, the panels feature an impervious, resinous surface enclosing a fiberglass reinforced core. An extremely light-stable, acrylic-modified polyester resin coating is chemically bonded to the basic polyester core before curing. The coating is completely compatible with the core resin.

Readers' Service Item 46

Textured Vinyl Carpeting

U. S. Royal vinyl carpet, developed by U. S. Rubber Co., is designed for indoor and outdoor use in motels, beach clubs, and restaurants, as well as inside banks, offices, and hospitals. Made in eight colors, this piled carpet is claimed to be weatherproof, mildewproof, markproof, and fire resistant. It can be cleaned with soap and water, rug shampoo, or vacuum cleaner.

The carpet can be installed on, above, or below grade, directly on most types of floorings. Over asphalt tile, lacquered surface, and linoleums, a lining felt is recommended.

Readers' Service Item 47

Foam Bed Pillow

Perma-Foam, Inc., is now producing a cored urethane foam bed pillow. Designated Style-Foam, the pillow is made in two sections which are individually convoluted and electronically sealed at the edges. Outwardly, it has the conventional crowned shaped. The cored air pockets are designed to add extra softness and resilience.

The pillow is available in three sizes with zippered ticking. The 22- by 28-inch pillow has a 7-inch crown; the 21- by 27-inch, a 6½-inch crown; and the 19- by 26-inch, a 6-inch crown. The pillow may be hand washed or steam sterilized.

Nopco Chemical Co. has supplied the urethane foam, made from du Pont's Hylene organic isocyanates.

Readers' Service Item 48

Coated Magnet Wire

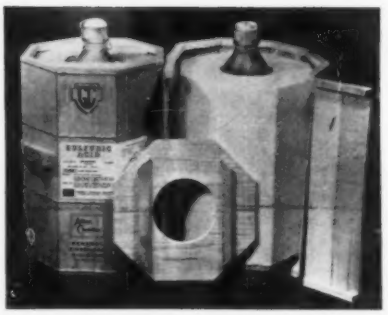
Speedy solderability is the outstanding characteristic of magnet wire coated with a urethane enamel now being offered to wire coaters. Carthane 8063, a product of Carwin Co., is claimed to halve the time required to solder single-coated No. 29 AWG.

Especially designed for dip application, the enamel, in both single and heavy builds, is resistant to most solvents, including acetone.

Readers' Service Item 49

Acid Carboy with Overpack

An acid carboy incorporating an expanded polystyrene overpack has been developed by Allied Chemical's general chemical division. The inch-thick, octagonal overpack of foamed-in-place expanded polystyrene, is reported to provide better protection and cushioning than was possible with previous packaging materials. The wooden outer shell is wirebound.



Foamed carboy overpack.

Dylite expandable polystyrene employed in the carboy is supplied by Koppers Co., who cooperated with general chemical in the initial design. The wirebound box was designed by Package Research Laboratory and produced by David M. Lea & Co.

Readers' Service Item 50

Disposable Foam Cups

A foamed polystyrene disposable drinking cup for hot or cold beverages is being introduced to the institutional feeding market by Mid-West-Pak Corp. and Crown Plastic Cup Co. Trademarked Thermokup, the cups are molded of Pelaspan, Dow Chemical Co.'s expandable polystyrene beads.

Because of the foam's insulating properties, the cups are reported to retain heat or cold far longer than paper or other plastic containers. Further, they will not transfer heat to the outside. One-piece construction eliminates seams and ensuing leakage. The Thermokup will not get soggy or change the flavor of a beverage.

The cups are available in six-, eight-, and 12-ounce capacities. Tight-fitting paper or transparent plastic lids can also be supplied. Mid-West-Pak is distributing in all states except seven in the southwest handled by Crown.

Readers' Service Item 51

PVC Jointing Members

Two PVC jointing members for masonry control joints offering improved holding power, lasting flexibility, and installation ease, have been announced by Electrovert, Inc., for concrete, cinder, or cement block wall constructions. Durajoint 20 is installed where lower cost fillers may be used; Durajoint 21 where fillers should not be used for aesthetic or structural reasons. Both are spliced at the installation site by heating the ends of the sections

"Our BIPEL Preform Rate jumped from 1900 to 3300 per hour!"
So reports General Industries Co., Elyria, Ohio . . . on their new BIPEL Horizontal Hydraulic Preformers. Leading producers everywhere are praising these faster, more flexible units. Are you getting maximum results? Write for complete information.
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COMPRESSION - TRANSFER PRESSES
HORIZONTAL HYDRAULIC PREFORMERS

and pressing them together until cool.

According to the company, the PVC used in these joints retains its elastomeric properties for the life of the structure. Embrittlement and breakage due to oxidation and fatigue are eliminated.

Readers' Service Item 52

Irradiated Polyolefin Tubing

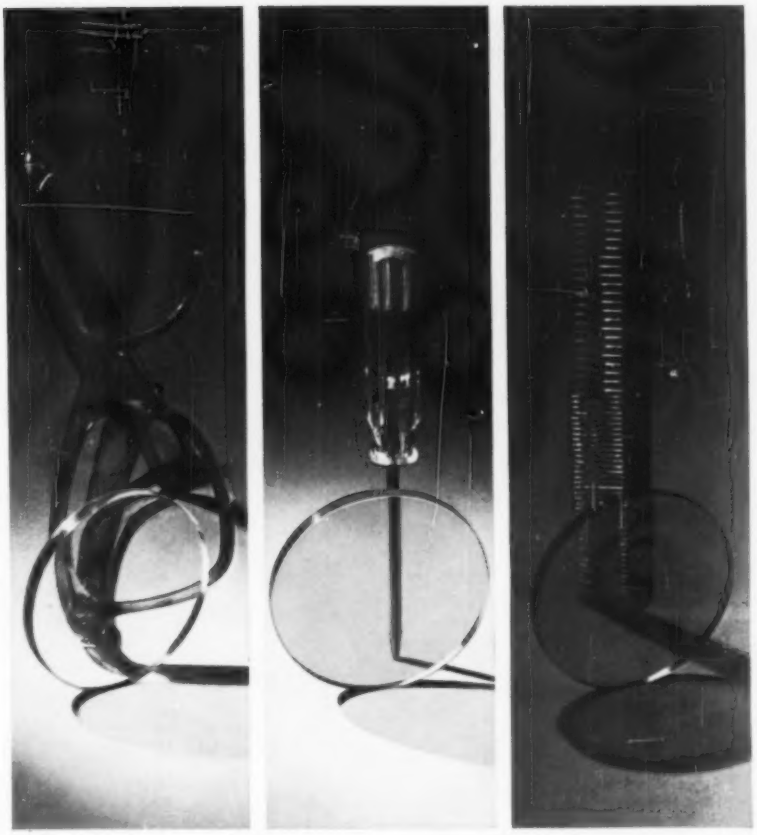
Sequoia Wire & Cable Co., a subsidiary of Anaconda Wire & Cable Co., has made available a polyolefin tubing and sleeving material which heat shrinks in diameter to form a tight bond, even over irregular shapes. Flame retardant and thermally stable, the tubing, designated Hyshrink, can be slipped over terminals, connectors, conduits, etc., in its expanded form. Upon application of heat (275° F.), the tubing shrinks in diameter to form a strong mechanical bond. Heating does not affect flexibility. Longitudinal shrinkage is less than 10%.

Hyshrink is said to be an excellent insulating material with high dielectric and mechanical strength and tested resistance to most chemicals. It resists fungus growth, gives off no toxic fumes, and will not melt, harden, flor, run, crack, or blister between —67° F. and 275° F.

It takes only a few seconds of heat to shrink the tubing to a predetermined size. Hot airguns, ovens, radiant heat, and hot liquids are recommended for this purpose. The tubing will remain at expanded diameter until heated.

Cable harness showing four Hyshrink applications.

Readers' Service Item 53



SALES-making SPARKLE and CLARITY
for cellulose acetate products

You're looking at the results of three methods of improving lacquers and molding powders with new high-quality Du Dont Cellulose Acetate.

This C/A sets a standard for sparkle and clarity. Shown here are three grades of Du Pont C/A: highest clarity (at left) for superior brilliance and sparkle, medium grade (center) for tinted and pigmented items, and a third grade for opaque products.

Other properties: Du Pont C/A is light stable. It is tough. It resists heat. It resists chemicals, grease, oil. It is an excellent electrical insulation.

Flaked or ground: Du Pont C/A can be supplied flaked or ground. You can have it in acetylations from 52% to 56% and in viscosities from 3 to 150 sec.

Available in 50-lb. multiwall bags.

For information on pricing and shipping arrangements, call your Du Pont representative, or write Du Pont, Explosives Department, 6539 Nemours Building, Wilmington 98, Delaware.

CELLULOSE ACETATE

DU PONT

Better Things for Better Living . . . *through Chemistry*

If you use
THERMOCOUPLES
call for
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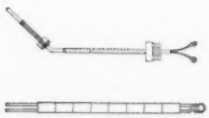
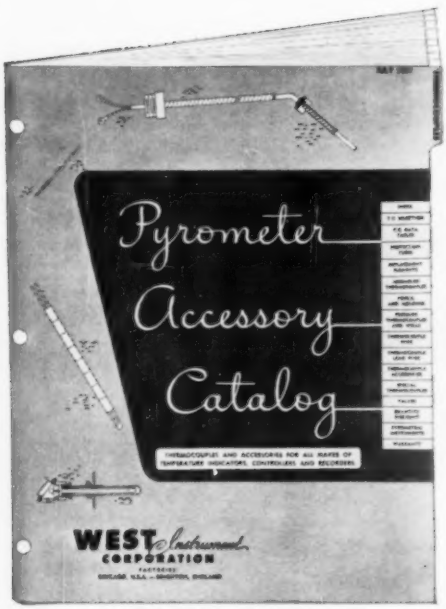


For *all* applications—for use with all standard types of temperature indicators, controllers, recorders—we make a complete selection of thermocouples from matched and checked wires, assuring constant millivolt output for accurate readings.



NEW DATA BOOK FREE

Revised 40-page file-size catalog

- Lists all data (I.S.A. standards), components and prices
- Graphically shows how to select best thermocouple and protective tube for each operation

Write for your new Thermocouple Data Book now

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Represented in Canada by Davis Automatic Controls, Ltd.

the trend is to WEST

Golf Swing Trainer

An aid to better golfing, the Golf Tutor, has been developed by pro golfer Tommy Armour to help the golfer improve his game by analyzing his swing. Made of aluminum and stainless steel, the Golf Tutor is mounted on a base molded of Dylite expandable polystyrene, a product of Koppers Co., Inc., by Modern Golf Enterprises, Inc.

Designed to reproduce actual playing conditions, the Golf Tutor may be used for practice anywhere that there is room to swing a golf club.

The Golf Tutor.

Readers' Service Item 54

Patterned Diffuser

Rotuba Extruders, Inc., has announced extrusion of prismatic panel Pattern R-7. Comprised entirely of hexagonal pyramids which permit light to enter at any angle from the light source, the diffuser is reported to direct and control light with great uniformity and little glare.

Pattern R-7 is presently extruded in polystyrene or acrylic up to 24 inches wide and in thicknesses of $\frac{1}{8}$ and $\frac{3}{16}$ inch. Manufactured in crystal clear or opal white, it can be made in varying degrees of translucency.

Readers' Service Item 55

RP Utility Boats for Navy

Lunn Laminates, Inc., is molding 40-foot utility boats for the Navy. The largest which Lunn has yet constructed for the Navy, the boats will accommodate 75 men with a three-man crew. The 165 hp., 1,800 rpm., diesel engine will drive the boat up to 18 knots with crew.

Readers' Service Item 56

New Literature

For more information check Readers' Service Card (p. 87)

"Handbook of Uniglass Fabrics." United Merchants Industrial Fabrics. 28 pages. A primer of glass fabrics and fibers. Weaves, finishes, and quality control are among the topics featured.

Readers' Service Item 61

"ABC's of Defoaming." Dow Corning Corp. 8 pages. Uses and characteristics three silicone antifoamers, A, B, and C, constitute the text.

Readers' Service Item 62

"Invert-A-Bin Semi-Bulk Handling Systems." Powell Pressed Steel Co. 4 pages. Shipping and storage containers for handling flowable dry products are described. Fabricated of steel or aluminum, in capacities up to 4,000 pounds, in sizes of 36, 65, and 88 cubic feet.

Readers' Service Item 63

"From Idea to Finished Product." Brochure No. 2—660. Weber Plastics, Inc. 6 pages. Illustrates many applications of expandable polystyrene, which the company molds. Properties and features of the material; services Weber provides.

Readers' Service Item 64

"Diisocyanates." National Aniline Division, Allied Chemical Corp. 8 pages. History, chemistry, and uses of diisocyanates. Urethane foam chemistry is explained to show how foam structure can be varied by reacting different compounds with the diisocyanate.

Readers' Service Item 65

"Plastic Mold and Die Cast Die Bases." Columbia Engineering Co., Inc. 26 pages. Illustrated catalog gives prices and design specifications for standard and special plastic mold and die cast die bases. Also lists steels and machining services available for plastic injection, compression, and stripper mold bases, and for die cast die bases.

Readers' Service Item 66

"Recommended Revision of Commercial Standard CS197-59." TS-5496. Commodity Standards Division, U. S. Department of Commerce. Improvements in flexible polyethylene plastic pipe are reflected in the revision, recently prepared in cooperation with SPI by the Commodity Standards Division. It covers specifications, workmanship, and methods of marking several types of pipe used principally for conveying potable water.

Readers' Service Item 67

"Vacuum Coating and Equipment." Bulletin 2-2. Consolidated Vacuum Corp. 28 pages. After a review of the history of vacuum coating, types of coatings and the vacuum coating cycle are outlined. Coating units manufactured by the company are graphically described.

Readers' Service Item 68

"PVC Plastisols." Bulletin MR-19-60. Rohm & Haas Co. 8 pages. Formulation with polymeric and monomeric plasticizers, treating viscosity characteristics. Data on initial viscosity and viscosity stability on aging are tabulated. Graphs detail plastisol gel and fluxing temperatures.

Readers' Service Item 69

"Property Chart for Diallyl Phthalates." Mesa Plastics Co. 2 pages. Electrical, structural, thermal, and other data on regular and flame retardant diallyl phthalate and diallyl isophthalate plastics are tabulated on a chart for wall mounting.

Readers' Service Item 70

"Plastics Properties Chart." Commercial Plastics and Supply Corp. 16 pages. Unusually complete property tabulation for thermoplastics, thermosets, and high pressure laminates.

Readers' Service Item 71

"Filon Translucent Fiberglass-and-Nylon Reinforced Panels." Form #144. Filon Plastics Corp. 8 pages. Builders, contractors, architects, and engineers will find in this bulletin complete technical and product data on Filon panels. It incorporates full testing details and conclusions about Filoplate, and specifications for Rololite, a cross-corrugated panel in roll form.

Readers' Service Item 72

"Motor Selection Guide." GED-3909A. General Electric Co. 2 pages. This three-by seven-inch card provides quick reference to frame size (182 to 445U) and book price for a-c motors from ¾ to 125 hp. Data for dripproof and enclosed fan-cooled Tri-Clad 55 squirrel cage horizontal motors are tabulated.

Readers' Service Item 73

"Coatings Selector." Bee Chemical Co., Logo Division. 7 pages. Classified by application surface, code number and product data of coatings are listed. Plastisols and metallizing systems are also tabulated.

Readers' Service Item 74

"Plastics Products Catalog." D400. Durez Plastics Division, Hooker Chemical Corp. 8 pages. Data on physical, mechanical, and electrical properties, as well as applications, are presented for Durez thermosetting phenolic and diallyl phthalate molding compounds, phenolic bonding and coating resins, and Hetron fire-retardant polyester resins for reinforced plastic laminates and molded shapes.

Readers' Service Item 75

"Porous Teflon and Kel-F Chemically Inert Filter Media." P-103. Porous Plastic Filter Co., Inc. 4 pages. Pore size, mechanical properties, chemical resistance, flow capacity. Cloth, sheet, and discs for filtering are available.

Readers' Service Item 76

"Bulletin No. P-103." Eastman Chemical Products, Inc. 6 pages. Eastman products are listed, some with property tabulations and others with textual descriptions. Categories include acids and anhydrides, aldehydes, aromatic intermediates, alcohols, plasticizers, solvents, and Epolene low molecular weight polyethylenes.

Readers' Service Item 77

"When You Come Face to Face with Automation." Rodgers Hydraulic Inc 4 pages. The described automatic preform heater-loader is adaptable to most molding presses. It is also claimed to be extremely reliable, fast, and accurate. Specifications of two models are listed.

Readers' Service Item 78

"Formica Designer's Fact Book." Formica Corp. 115 pages. This new edition contains property and application data covering 70 standard, special and molding grades of high-pressure thermosetting laminating plastics; military specs; a grade comparator chart; tolerance and weight specifications; and nation-wide fabricating facilities. Sample applications are clearly illustrated.

Readers' Service Item 79

"Do You Need These Impact Strength Properties in Your Product?" Naugatuck Chemical Division, U. S. Rubber Co. 4 pages. Kralastic MH, a high impact ABS resin, is fabricated by injection molding, vacuum forming, profile and sheet extrusion. It lends itself to many finishing operations, and is recommended for prepar-ing comprehensive prototypes.

Readers' Service Item 80

Book Reviews

"Analytical Chemistry of Polymers. Part I: Analysis of Monomers and Polymeric Materials—Plastics, Resins, Rubbers, Fibers." Edited by Gordon M. Kline. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6¼ by 9¼ inches, 666 pages. Price, $16.50.

This volume is a compilation of the analytical methods that have proved to be useful in the testing of commercial monomers and polymers. For each of the major industrial types of polymers, methods for the assay and determination of pertinent impurities in the monomers are described. A discussion of identification and characterization of chemical composition and physical properties of polymers follows. Generally, procedural details are supplied only in the case of previously unpublished tests or modifications of well-known tests for the particular requirements of monomer or polymer analysis. Otherwise, principal features of a method and equipment are presented in abbreviated form and the reader is referred to the original literature for detailed directions.

In addition to such chapters as alkyds, amino resins, polyamides, and polyesters, special chapters dealing with identification and analysis of plasticizers, ion exchange resins, rubbers, fibers, and drying oils have been included.

"Development of Foamed-in-Place Plastic Energy Absorbing Materials." R. C. Bryant, W. D. Steward, et al. Atlantic Research Corp. for Quartermaster Research and Engineering Command, U. S. Army. PB 151436, OTS, U. S. Department of Commerce, Washington 25, D. C. 80 pages. $2.00.

In this study, to develop more effective cushioning materials for use in delivery by aerial drop, a process for producing foamed-in-place plastics that provide equal or better cushioning than foamed glass was found. The report describes the chemical reactions found in producing the modified castor oil polyurethane systems.

"Chemical Analysis of Resin-Based Coating Materials." Edited by C.P.A. Kappelmeier. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 6¼ by 9¼ inches, 630 pages. $19.50.

This book, aimed at the paint or coating specialist, outlines the theory, method, and technique of chemically analyzing resin-based coatings. An analytical discussion of several important synthetic resins is followed by chapters on the identification of coating materials ready for use.

Among the component materials discussed are clear oil varnishes, alkyd resins, styrene-modified oils, pigments, solvents and thinners, and latices. Analysis of coating materials by infrared spectrophotometry, steam distillation, and complex compound technique is featured, as is a special section on lacquers.

"Current Projects of the American Standards Association." American Standards Association, Inc., 70 E. 45th St., New York 17, N. Y. Paper, 8½ by 11 inches, 52 pages. $.75 for members, $1.50 for non-members.

Sponsors, chairmen, and scopes of 425 American Standards project committees are described. A preface explains the operation of the organization and the arrangement of the pamphlet.

"NEL Reliability Bibliography." Supplement 2. Compiled by W. E. Jorgensen, I. G. Carlson, and C. G. Cros. OTS, Department of Commerce, Washington 25, D. C. Paper, 7¾ by 10¼ inches. $2.25.

Abstracts, four per page, are numbered for interfiling in appropriate sections of the basic "NEL Reliability Bibliography." Of the ten sections in the original volume, abstracts on failure analysis, general, human engineering, maintenance, mechanical design, systems and testing topics are included in the supplement.

The publication is issued as part of a cooperative program between the Navy Electronics Laboratory of the Bureau of Ships and industry to promote reliability in the design and production of electronics equipment.

"Nature and Properties of Engineering Materials." Zvigniew D. Jastrzebski. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Cloth, 6¼ by 9½ inches, 571 pages. $11.00.

This college textbook on materials comprises an excellent description of the theoretical principles which form a basis for the understanding of the properties and behavior of matter. Professor of engineering at Lafayette University, the author has brought to the job not only considerable knowledge of all engineering sciences, including nuclear physics, but valuable teaching experience as well. The book reflects his interest in combining understanding of fundamental principles with practical application.

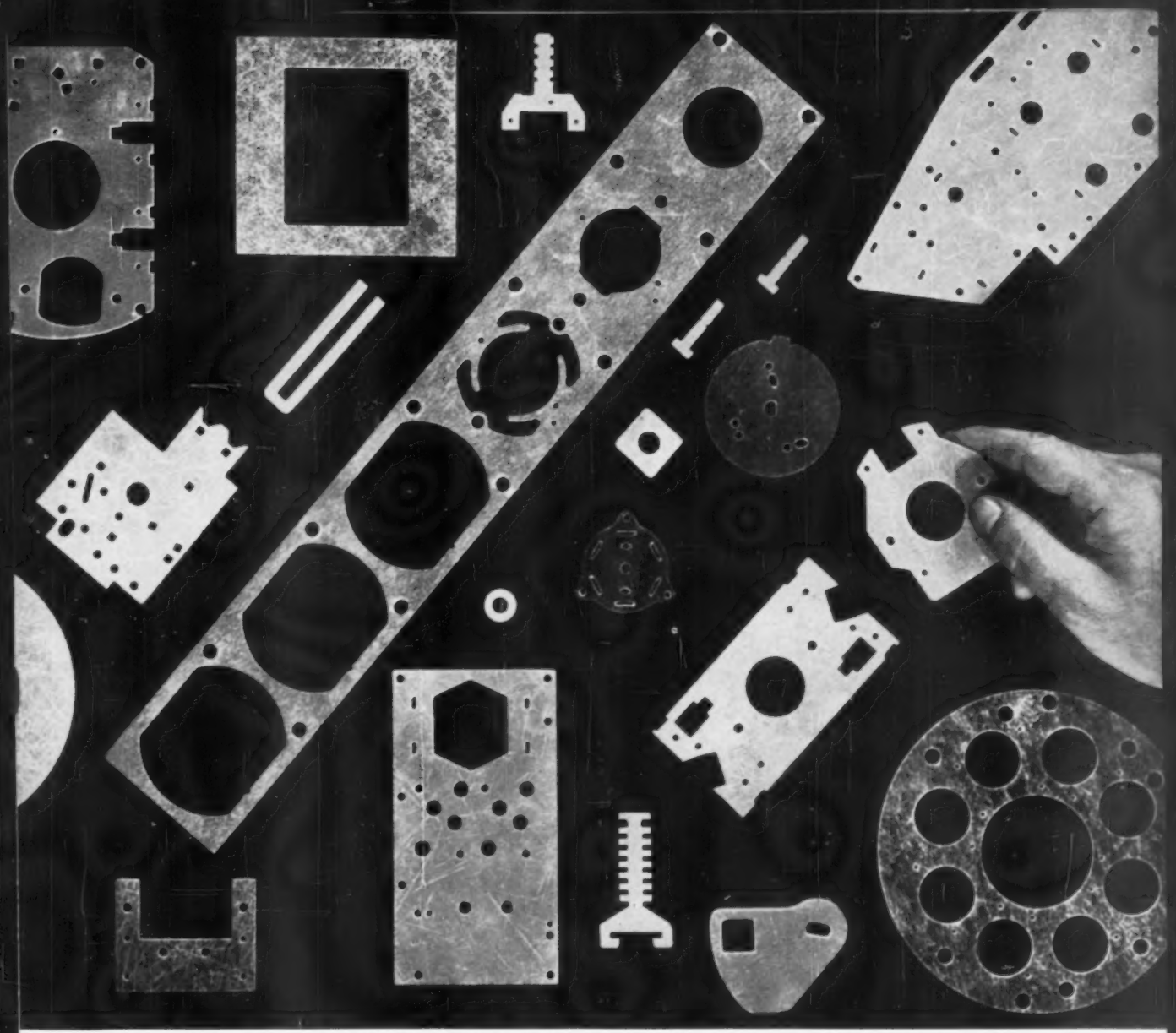
Dr. Jastrzebski's book is divided into 12 chapters. The first, which begins with an introduction to the Bohr atom and the atomic and electronic structure of matter, goes on to explain interatomic and intermolecular (Van der Waal) forces and their relationship to the structural characteristics of both crystalline and amorphous materials. The next three chapters continue the presentation of fundamentals. The second presents a physicochemical description of colloidal materials and emulsions. Specific polymeric materials, their molecular structure, and the mechanics of polymerization are described. The third deals with the phenomena of diffusion and crystalline nucleation, phase transformation in solids, and phase equilibria between liquids and solids. The fourth, and final fundamental chapter, goes into mechanical behavior and structural characteristics of solids. Elasticity, plasticity, and flow characteristics are given in terms of the main types of engineering materials. The chapter concludes with discussion of properties related to strength and radiation damage.

The next two chapters cover the characteristics and production of specific metals and ceramics. Chapter seven deals with electrical and magnetic properties of materials. These are discussed from the point of view of solid state physics, as this study has made a most significant contribution to the development of new materials for electronic devices. The underlying differences between insulators and semiconductors are also pointed out. The section on thermal properties follows.

Corrosion is explained in chapter nine by means of electrochemistry and surface chemistry. Mechanism, forms, treatment, and prevention of corrosion are explained through reference to experimental evidence and projected theory. Phenomena of friction, wear, and lubrication are similarly explained in chapter ten from the point of view of surface physics and surface chemistry. Asperites are considered in the study of sliding and rolling friction.

The book concludes with a section on bonding and joining, and protective materials. The former explains the joining processes, including welding, brazing and soldering, and adhesives. Half the chapter is used to discuss specific inorganic cements and concrete. The final chapter, closely related to that on corrosion, includes plating of various substrates and the organic and inorganic coating materials: metallic, chemical conversion, organic, and ceramic.

Because this is a working textbook, each chapter ends with a set of problems and a bibliography. Dr. Jastrzebski's book is recommended as a text for educators and as a reference for the professional engineer, laboratory technician, inventor, and designer.



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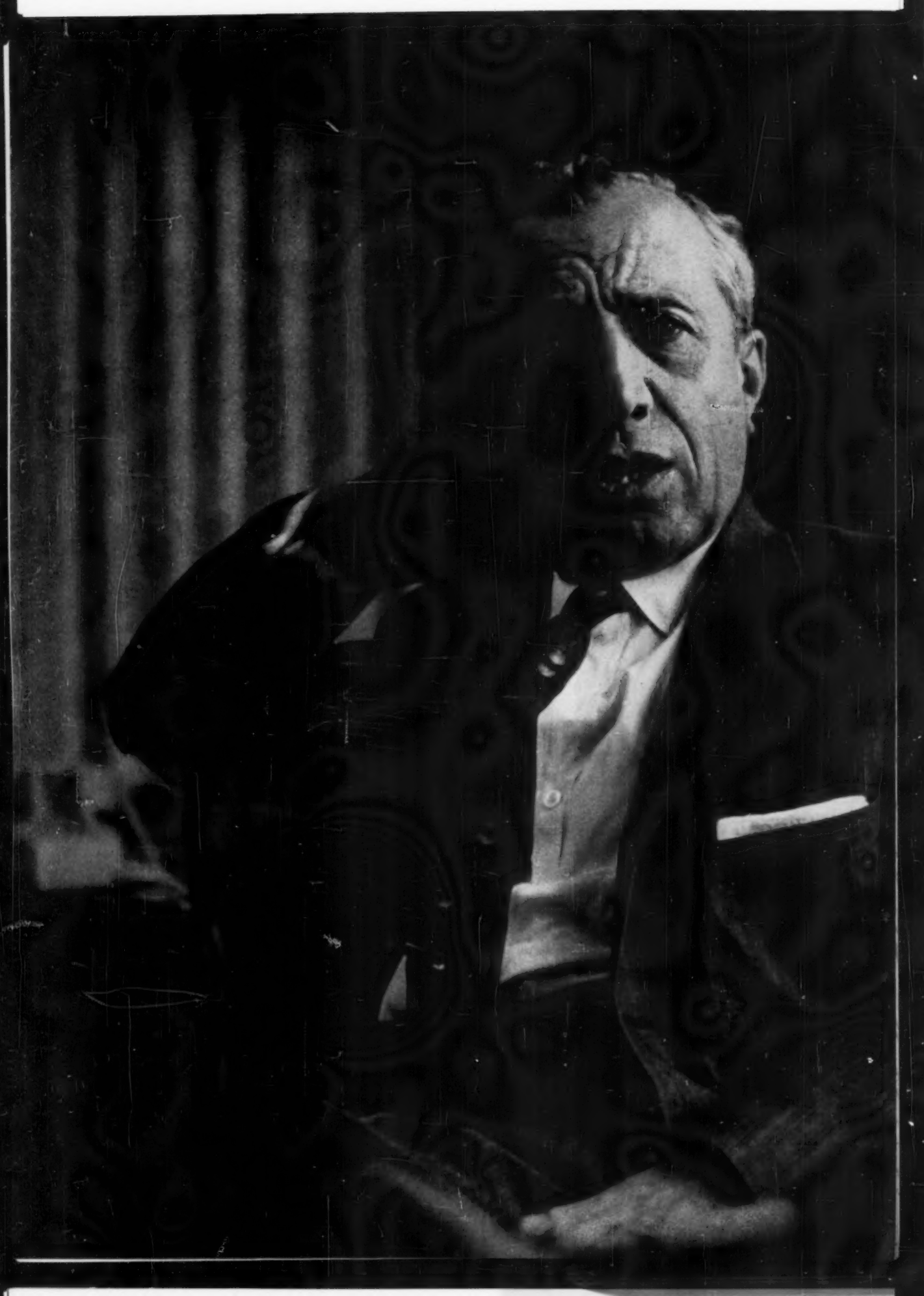

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Patent Digest

Materials

Styrene-Modified Rubbery Compositions Stabilized with 2-Nitrophenols. No. 2,943,-075. W. K. Schweitzer, Jr., Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Haloethylene Polymers Stabilized with Diesters of Aliphatic Dicarboxhlic Acids and Hydroxy Benzophenones. No. 2,943,-076. C. B. Havens and G. A. Clark, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Heat Sealable Thermoplastic Film. No. 2,943,000. T. W. Austin, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Copolymers of Ethylene and Sulfur Dioxide. No. 2,943,077. R. B. de Jong and I. M. Robinson, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Cellular Polyester-Urethane Resin and Preparation of Same. No. 2,937,152. D. N. Hunter, Luton, England (to D. Napier & Son Ltd., London, England).

Haloethylene Polymers Containing Allyl Ethers of 2-Hydroxy Benzophenones. No. 2,937,157. G. A. Clark, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Stabilized Phenol-Formaldehyde Resins. No. 2,937,159. A. F. McKay, Pointe Claire, Quebec, and C. Podesva, Montreal, Quebec, Canada (to Monsanto Canada Ltd., Ville La Salle, Quebec, Canada).

Polyamides of Bicyclos-(3,3,0)-Octane-1,4-Dicarboxylic Acid. No. 2,937,162. J. C. Martin and J. R. Caldwell, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Cross-Linking of Ethylene Polymers with Peroxide Catalyst and Composition Therefor. No. 2,938,012. L. J. Filar, Newark, Del. (to Hercules Powder Co., Wilmington, Del.).

Olefin/Maleic Anydride Copolymers of Low Molecular Weight. No. 2,938,016. J. H. Johnson, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

Transparent Molding Compositions of Copolymers of Vinyl Aromatic Hydrocarbons and Esters of Methacrylic Acid and Copolymers of Butadiene and Styrene and Method of Making. No. 2,941,977. A. F. Roche, Freeland, B. H. Tubbs, Clare, and C. Jones, Linwood, Mich. (to Dow Chemical Co., Midland, Mich.).

Vinyl Chloride Resin Stabilized with Dibutyl Tin Bis (Propyleneglycol Maleate). No. 2,938,013. G. P. Mack, Jackson Heights, and E. Parker, New York, N. Y. (to Carlisle Chemical Works, Inc., Reading, O.).

Non-Blocking Polyethylene Compositions. No. 2,938,879. H. W. Mock, Elizabeth, and W. A. Haine, Scotch Plains, N. J. (to Union Carbide Corp.).

Cured Epoxy Resin Composition Containing Boron Trifluoride Complex of a Monoethylamine and Piperidine, Method of Curing Said Composition and Glass Fibers Impregnated Therewith. No. 2,938,-880. W. R. Bailey, Washington, D. C.

Vinyl Aromatic Polymers Stabilized with N-Methylaminoalkanols. No. 2,938,882. W. K. Schweitzer, Jr., Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Chloroethylene Polymers Stabilized with Monoacrylic Esters of Hydroxy Phenones. No. 2,938,883. W. J. Raich, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Asymmetric Polyamides. No. 2,938,-885. J. A. Blanchette, E. Longmeadow, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Chloroprene Copolymers. No. 2,938,-888. E. S. Lo, Elizabeth, N. J. (to Minnesota Mining and Mfg. Co., St. Paul, Minn.).

Polymer Blend of a Carboxyl-Containing Monovinylidene Aromatic Polymer and a Carboxyl-Containing Conjugated 1,3-Diene Polymer. No. 2,944,044. M. Baer. Longmeadow, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

Light Resistant Copolymer of Poly(Alkylene-Maleate-Hexahydro Orthophthalate) and Styrene. No. 2,939,858. W. Cummings, N. Woodbury, Conn. (to U. S. Rubber Co., New York, N. Y.).

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices, 25c each
—The Editor

Oxypropylation of Phenolic Resins. No. 2,938,884. D. M. Chern, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

Aromatic Epoxidized Polyester and Method of Making. No. 2,944,035. R. L. Wear, W. St. Paul, Minn. (to Minnesota Mining & Mfg. Co., St. Paul, Minn.).

Neopentyl Glycol Alkyl Phthalates and Polyvinyl Chloride Compositions Plasticized Therewith. No. 2,944,041. A. C. Hecker, Richmond Hill, and M. W. Pollock and I. Rabinovici, New York, N. Y. (to Argus Chemical Corp.).

Stabilized Vinyl Resin Compositions. No. 2,944,045. C. M. Canarios, Maple Heights, O. (to Harshaw Chemical Co., Cleveland, O.).

Plastic Molding Material. No. 2,940,-885. D. J. Burke, E. Cleveland, O. (to Erico Products, Inc., Cleveland, O.).

Composition Containing Polypropylene and an Ester Plasticizer. No. 2,940,949. D. R. Mullin, Chester, Pa. (to Sun Oil Co., Philadelphia, Pa.).

Olefin Copolymer. No. 2,940,955. E. C. Shokal, Walnut Creek, and P. A. Devlin, Orinda, Calif. (to Shell Oil Co.).

Modified Polyesters. No. 2,934,513. D. D. Hicks and J. E. Masters, Louisville, Ky. (to Devoe & Raynolds Co., Inc.).

Method for the Preparation of Foamed Polyurethanes. No. 2,933,462. J. R. Fischer, Monrovia, Calif. (to Aerojet-General Corp., Azusa, Calif.).

Reaction Product of Dextran-Modified Polyester with Organic Diisocyanate and Method of Producing Same. No. 2,933,463. L. J. Novak, Dayton, O. (to Commonwealth Engineering Co. of Ohio, Dayton, O.).

Polyvinyl Chloride Resins Stabilized with Mixtures of Phosphonate Esters, Epoxy Compounds, and Metallic Salts of Fatty Acids. No. 2,934,507. D. H. Chadwick, St. Louis, and T. Reetz, Webster Groves, Mo. (to Monsanto Chemical Co., St. Louis, Mo.).

Vinyl Chloride Resins Stabilized with Titanium Chelates. No. 2,933,465. H. M. Olson, Hudson, O. (to Harshaw Chemical Co., Cleveland, O.).

Patent Digest (Cont'd.)

Method for Producing a Cured Expanded Phenolic-Aldehyde Resin. No. 2,933,461. G. A. Mullen, Pittsburgh, Pa. (to Westinghouse Electric Corp., E. Pittsburgh, Pa.).

Process for Treating Polyethylene Film. No. 2,934,457. J. C. Elliott, Madison, Wis. (to Bjorksten Research Laboratories, Inc.).

Blends of Vinylidene Chlorofluoride Polymers with Ethylene/Vinylene Carbonate Copolymers. No. 2,934,514. I. O. Salyer and J. D. Calfee, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

Heat-Resistant Resins and Laminates. No. 2,936,260. G. Alexander, Pittsfield, Mass. (to General Electric Co.).

Room Temperature Curing Silicone Resins. No. 2,934,519. H. A. Clark, Midland, Mich. (to Dow Corning Corp., Midland, Mich.).

Poly(Ethylene Oxide) Stabilized with Propyl Gallate. No. 2,934,518. K. L. Smith, Charleston, W. Va. (to Union Carbide Corp.).

Sealing Irradiated Polyethylene. No. 2,936,261. Q. P. Cole, Pittsfield, Mass. (to General Electric Co.).

Preparation of Cellular Polyamide-Epoxy Resin Compositions. No. 2,936,294. R. C. Kohrn, Pawtucket, R. I. (to U. S. Rubber Co., New York, N. Y.).

Copolymers of Vinyl Acetate and Fumerate. No. 2,936,300. T. S. Tutwiler, Watchung, and W. C. Hollyday, Jr., Fanwood, N. J. (to Esso Research and Engineering Co.).

Polytetrafluoroethylene Granular Powders. No. 2,936,301. P. E. Thomas, Wilmington, and C. C. Wallace, Jr., Newark, Del. (to E. I. du Pont de Nemours & Co.).

Equipment

Blow Molding of Hollow Plastic Ware. No. 2,936,481. J. M. Wilkalis and W. H. Peiler, W. Hartford, Conn. (to Plax Corp., W. Hartford, Conn.).

Manufacture of Lengths of Synthetic Plastic Material. No. 2,936,483. S. T. Deakin, Ewell West, England (to Siemens Edison Swan Ltd., Westminster, London, England).

Apparatus for Making Ring Closures. No. 2,936,485. A. Jauss, Stuttgart-Bad Cannstatt, Germany (to Bohm & Co., Stuttgart-Bad Cannstat, Germany).

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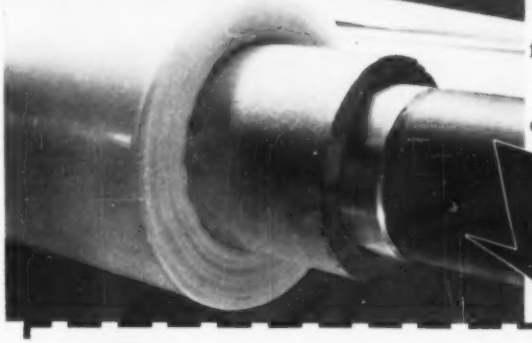

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Dibutyl Sebacate	0.935	7.9	Vinyl Resins, Cellulose Acetobutyrate, Synthetic Rubbers, Rubber Hydrochloride, Polymethyl Methacrylate	Low Temp. Flexibility, Excellent Aging Qualities, Non-Toxic
Dimethyl Sebacate	0.986*	3.54 @30°C	Vinyl Resins, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate, Acrylic Resins	High Solvency and Efficiency, Wide Compatibility, Concentrated Source of Sebacyl Radical
Dioctyl Sebacate	0.913	17.4	Polyvinyl Chloride and Copolymers, Polyvinyl Butyral, Synthetic Rubbers, Cellulose Nitrate, Cellulose Acetobutyrate	Excellent Low Temp. Flexibility, Low Volatility, Excellent Soapy Water Resistance, Good Electricals

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Method and Apparatus for Flattening Beaded Edges of a Film. No. 2,922,190. T. J. Higgins, Jr., Fredericksburg, Va. (to American Viscose Corp., Philadelphia, Pa.).

Device for Removing the Sprue from Objects Produced by Injection Molding Operations. No. 2,923,031. J. R. Collion, Lyon, France (to A. Nothelfer & Sohne, Ravensburg, Germany).

Mold with Self-Trimming Portion. No. 2,923,032. T. A. Miller and T. A. Miller, Jr., Cuyahoga Falls, O.

Treatment of Surfaces of Polyethylene Resins. No. 2,923,964. S. Plonsky, Elmhurst, N. Y. (to Celanese Corp. of America, N. Y., N. Y.).

Extrusion Apparatus. No. 2,923,970. A. L. Genovese, Odenton, Md. (to National Plastic Products Co., Odenton, Md.).

Extrusion Nozzle. No. 2,923,971. S. C. Nelson, Fredericksburg, Va. (to American Viscose Corp., Philadelphia, Pa.).

Extruder and Strainer Plate Therefor. No. 2,923,972. A. DeGhetto, Clifton, N. J. (to National Rubber Machinery Co., Akron, O.).

Method for Molding a Tube of Plastic Material, Device for Carrying Out This Method, and Method for Utilizing This Device. No. 2,923,975. B. Voumard and P. Monnier, La Chaux-de-Fonds, Switzerland (to Voumard Machines Co., S. A., La Chaux-de-Fonds, Switzerland).

Injection Molding Press. No. 2,923,976. W. Strauss, Philadelphia, Pa. (to F. J. Stokes Corp., Philadelphia, Pa.).

Plastic Laminating Machine. No. 2,927,620. A. F. Elliott, Norwalk, Calif.

Process and Apparatus for the Manufacture of Hollow Articles. No. 2,928,120. K. M. Leghorn, Berkeley Heights, and J. B. Meister, Morris Plains, N. J. (to American Can Co., New York, N. Y.).

Apparatus for Continuously Coating a Cord with Rubber or Other Thermoplastic Material. No. 2,928,122. H. W. Trevaskis, Solihull, England (to Dunlop Tire and Rubber Corp., Buffalo, N. Y.).

Plastic Material Extrusion Head. No. 2,938,123. J. H. Ramsey, Ramsey, N. J.

Mold Structure. No. 2,928,126. R. M. Heller, Birmingham, Mich. (to Watts Electric & Mfg. Co., Birmingham, Mich.).

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Article Abstracts

Materials

"Kinetics of the Crystallization of Low Pressure Polyethylene," J. Majer, J. Belusa, and J. Lanikova, KUNSTSTOFF-RUNDSCHAU, 7, 1, 39 (Jan. 1960).

Includes the relations of crystallization temperature and melt conditions to rate of crystallization and the effect of melt conditions on the shape of crystallization isotherms. Isotherm, analysis indicates that crystallization is determined by thermal nucleation and growth of globular spherulites. (In German).

"Boron-Siloxane Elastomers," M. Wick, KUNSTSTOFFE, 50, 8, 433 (Aug. 1960).

Boron containing dimethyl polysiloxanes, known as "bouncing putty," contain more htan 0.5 mole% boron, are susceptible against hydrolysis and cannot be cross-linked to form elastomers. Heterocondensates based on organopolysiloxanes and boric acid and organoboric acids with molecular weights of 100,000-600,000 can be cross-linked to form elastomers if they contain less than 0.5 mole% boron. These elastomers fuse together at room temperature, are not susceptible against hydrolysis, and have excellent electrical properties even after immersion in water.

"A General Method for the Estimation of Antioxidants in Polythene," K. Metcalfe and R. F. Tomlinson, PLASTICS (LONDON), 25, 274, 319 (Aug. 1960).

A method of test is presented.

"The Microscopic Examination of Rubbers, Plastics and Fillers," Margot Stephens and N. H. Langton, PLASTICS (LONDON), 25, 274, 329 (Aug. 1960).

Some methods on electron microscopy are given.

"The Thermodegradation Mechanism of PVC," J. Novak, KUNSTSTOFFE, 50, 5, 291 (May 1960).

From the side effects of the reaction mechanism of thermodegradation of PVC, conclusions are drawn as to the site of the liberation of hydrogen chloride and the causes leading to color changes. Main responsibility for the phenomena observed is ascribed to the effect of oxygen. (In German.)

"Specific Heat of Low Pressure Polyethylene," H. Wilski, KUNSTSTOFFE, 50, 5, 281, (May 1960).

The mean specific heat and the enthalpy of low-pressure Hostalen, (polyethylene) at 20 C., were determined in over a temperature range of 0-250° C. Heat of fusion was calculated from these data. Behaviors of the Hostalen types GD GF and GM were practically identical, but because of its high crystallinity, Hostalen GC differed. (In German.)

"Preparation of Thermosetting Polyvinyl Resins," S. A. Szewczyk, IND. PLASTIQUES MOD., 12, 6, 25 (July 1960).

Starting from halogenated polyvinyl esters, phenoxy, beta-bromo-propionate and bromo-11-undecanoate derivatives were prepared, each capable of condensing with formaldehyde. The properties of the resulting thermosetting resins are described. Thermosetting polyvinyl-polyamide resins were produced by condensing polyvinyl glycollate and polyvinyl amino-11-undecanoate with formaldehyde or with diacids. (In French.)

"Copolymers of Methylmethacrylate and Styrene for Molding and Extrusion," BRIT. PLASTICS, 33, 5, 195 (May 1960).

After comparing polystyrene and polymethyl methacrylate and briefly considering copolymerization problems, the author deals with the properties of an experimental copolymer (63:37) of methylmethacrylate and styrene. This copolymer has better molding characteristics than polymethyl methacrylate, can be extruded, and is remarkably suitable for a number of acrylic type applications.

"Tracking as a Possible Cause of Explosions," E. F. Richter and W. Knittel, KUNSTSTOFFE, 50, 5, 267 (May 1960)

To determine whether the results obtained with a standard creep-resistance test are valid for all electro-technical applications, experiments were conducted on the flammability of tracking currents and their premature discharge in a toluol vapor/air mixture; 57 different materials being examined. Readings could be taken before, during, and after explosion, but correlation between flammability and results of tracking experiments proved inadequate for practical purposes, so that a special test method will have to be developed. (In German.)

"Dynamic Behavior of Rigid PVC," S. Wintergerst, KUNSTSTOFFE, 50, 5, 277 (May 1960).

Starting from rotary flex tests on rigid PVC rods carried out in a temperature range of −30 and +50° C., fatigue was determined by Wohler curves, and the increase in temperature of the rods served as basis for determining internal damping of the material. Examination of the fractured surface gave information on the fracture mechanism. (In German.)

"Long Term Stress Resistance of Resin/Glass Laminates in Different Environments," J. J. Millane, BRIT. PLASTICS, 33, 5, 199 (May 1960).

Long term flexural strength of different resins was tested in varying environments with special apparatus similar to that used by B. B. Pusey. It is shown that when glass fiber is the filler, the strength of the laminate is seriously affected by water, and measures to counteract this are suggested.

"The Araldite Epoxide Resins," P. Pazzucconi, POLIPLASTI, 8, 39, 36 (March-April, 1960).

After considering the properties of Araldite that make it suitable for protecting surfaces, the author describes applications as anti-corrosive surfacing in factories, for apparatus, in roofing, and floorings for roads, ships' decks, tanks, underwater finishes for boats, elastic joints, etc. (In Italian.)

Equipment

"Welding Techniques for Plastics Sheeting," R. Valecka, KUNSTSTOFFE, 50, 10, 590 (Oct. 1960).

After classifying heat sealing and heat impulse welding methods, the conditions for high-frequency welding of film and sheeting are discussed, as well as the possible welding of non-thermoplastic materials and supports such as cardboard, chipboard, etc., to thermoplastic sheeting using special auxiliaries.

"Heat Conditions in an Injection Molding Machine," H. Hofmeister and W. Knappe, KUNSTSTOFFE, 50, 10, 541 (Oct. 1960).

Heat conditions in the heating barrel of a commercial machine are discussed, with the aid of experimental results.

"High Frequency Preheating of Thermosetting Molding Materials," F. Kann, KUNSTSTOFFE, 50, 10, 585 (Oct. 1960).

In the reference system used, the first number following the magazine name is the volume number, the second is the issue number (if any), and the third is the first page on which the abstracted article appears in that magazine.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines is printed here quarterly.

The next complete listing will appear in February. The last listing appeared in the October issue.

High-frequency preheating has been successfully used for some years to permit the molder to speed up his production. Correct use of this equipment is described.

"Copyright of Mold Designs," H. Issel, KUNSTSTOFFE, 50, 9, 483 (Sept. 1960).

The problems of copyrights of molds apply particularly to molds made by the molders for certain customers. The legal and tax aspects are discussed.

"Electronic Instrument for Investigating Shock Resistance of Plastics Films," H. Grimminger, KUNSTSTOFFE, 50, 9, 491 (Sept. 1960).

A tear instrument has been developed for subjecting plastic film to uniaxial or multiaxial tearing at a progressive speed of 7 mm./sec. A complete force-deformation curve is obtained during the test.

Applications

"Polyamide 11, Rilsan, Tubes in the Automobile Industry — Motor Fuel Piping," J. Fouque, IND. PLASTIQUES MOD., 12, 6, 19 (July 1960).

Motor fuel pipe made of Rilsan (Polyamide 11) has several advantages over copper and Armco pipe. Special tests also demonstrate its satisfactory behavior when subjected to a stream of centrifugally-projected pebbles. (In French.)

"Prospects of Polyester and Polypropylene Films for Food Packaging," S. Antiochia and L. Lucchetti, MATERIE PLASTICHE, 25, 8, 658 (Aug. 1959); POLIPLASTI, 7, 34, 20 (July-Aug. 1959).

The advantages of polyester and polypropylene films are explained, particularly for food packaging. In a table the physical and chemical properties of these films are compared with those of cellophane films of polyethylene, vinyl, and polystyrene. (In Italian.)

"Application of Montivel in the Decorative Field," S. Antiochia, MATERIE PLASTICHE, 26, 5, 438 (May 1960).

Montivel polyester film is finding increasing use in the decorative field in Italy. Among the applications described are metallized Montivel/PVC laminate as upholstery material, particularly for automobiles and in footwear; non-metallized Montivel in the form of straw; and in colored, transparent film for a variety of purposes. (In Italian.)

"New Developments in the Field of Acrylics," F. Esser, KUNSTSTOFFE, 50, 5, 309 (May 1960).

The author shows that the recent developments in the application of acrylics for clocks, in advertising and displays, and in the sanitary and building fields are due not only to the properties of the material, but also to the fact that manufacturers have been able to meet customers' requirements as to appearance and properties. (In German.)

General

"Plastics in Europe: Holland," A. G. Wansink, PLASTICS (LONDON), 25, 276, 380 (Oct. 1960).

A review of plastics developments in Holland, emphasizing that the big advance dates back to World War II.

"Plastics in Europe: France," M. Charreyron, PLASTICS (LONDON), 25, 276, 386 (Oct. 1960).

A review of current developments in plastics in France.

"Macromolecular Symposium," R. J. Phillips, RUBBER & PLASTICS AGE, 41, 10, 1185 (Oct. 1960).

The conclusion of a two-part report on the Symposium held in Moscow last June.

"1959 Report of Technical Standards Committee Plastics (FNK) in the DNA," O. Herrmann and G. Ehlers, KUNSTSTOFFE, 50, 10, 556 (Oct. 1960).

Details of further progress in standardization in the plastics field during the period from May 1959 to July 1960.

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CALENDAR of COMING EVENTS

January 24-27
SPE Seventeenth ANTEC. Shoreham Hotel, Washington, D. C.

January 24
General Electric Plastics Department Alumni, Annual Meeting. Shoreham Hotel, Washington, D.C.

February 7-9
SPI Sixteenth Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago, Ill.

February 20-23
Technical Association of the Pulp and Paper Industry. Annual Meeting. Hotel Commodore, New York, N. Y.

February 26-March 1
American Institute of Chemical Engineers. Petrochemical and Refining Exposition. Municipal Auditorium, New Orleans, La.

March 15-16
American Society of Tool and Manufacturing Engineers and SPE. Seminar on Plastics for Tooling. Hotel Statler, Detroit, Mich.

March 21-30
American Chemical Society. 138th National Meeting. St. Louis, Mo.

April 20-21
SPI Eighteenth Annual Western Section Conference. Hotel del Coronado, Coronado, Calif.

April 25
SPE Central Indiana Section RETEC. Plastics for Tooling. Indianapolis, Ind.

May 9
SPE Detroit Section RETEC. Plastics in the Automotive Industry. Detroit, Mich.

May 22
ASME Design Engineering Conference and Show. Cobo Hall, Detroit, Mich.

June 5-9
SPI National Plastics Conference. Commodore Hotel, New York, N. Y.

June 5-9
SPI Ninth National Plastics Exposition. Coliseum, New York, N. Y.

June 11-15
ASME Summer Annual Meeting. Statler Hilton, Detroit, Mich.

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A. C. Martinelli
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Abstract of Important Articles (Cont'd.)

General

"Plastics in Europe: Belgium," P. Bourgois, PLASTICS (LONDON), 25, 276, 390 (Oct. 1960).

The outlook for plastics materials in Belgium is shown to be favorable.

"Plastics at the 38th Milan Fair," L. Rizzi, S. Croce, E. Ferraris & A. Osella, MATERIE PLASTICHE, 24, 6, 491 & 561 (June 1960).

With the aid of 161 illustrations, the story of plastics applications as shown at the 38th Milan Fair, is told by the first three authors in three separate articles. 52 additional illustrations accompany the fourth article, describing the plastics machinery exhibited on this occasion. (In Italian.)

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Ovens, Grinders, Powder Mixers, Injection Molding Machines 1 oz. to 60 ozs. never used and used, Two, Three, Four-Head Blow Molding Machines, Extruders, granulators and refrigeration systems.

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Domestic Production and Sales of Plastics and Resin Material, July and August, 1960

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of July and August, 1960. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	July, 1960		August, 1960	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,346,062	1,334,784	1,429,323	1,479,692
Sheets, 0.003 gage and over	1,849,727	1,454,059	1,745,549	1,771,676
All other sheets, rods, and tubes (including other cellulose plastics)	585,692	581,644	668,796	867,870
Molding and extrusion materials (including other cellulose plastics)	6,854,377	5,956,763	7,729,779	7,559,979
Nitrocellulose sheets, rods, and tubes	—	94,958	187,858	103,544
TOTAL	10,635,858	9,422,206	11,761,305	11,782,761
Phenolic and Other Tar-Acid Resins:				
Molding materials	12,001,621	11,505,977	15,317,519	15,745,388
Bonding and adhesive resins for—				
Laminating (except plywood)	4,334,612	2,898,756	6,036,711	3,965,432
Coated and bonded abrasives	636,470	621,898	1,303,610	1,095,691
Friction materials (brake linings, clutch facings, and similar materials)	665,633	877,470	895,849	924,626
Thermal insulation (fiber glass, rock wool)	2,993,664	2,724,303	3,661,498	3,730,397
Plywood	3,341,212	2,900,941	5,456,995	3,959,468
All other bonding and adhesive uses	4,396,849	4,462,595	6,199,090	6,718,765
Protective-coating resins unmodified and modified except by rosin	1,871,596	1,817,032	2,026,902	1,635,293
Resins for all other uses	2,460,305	2,345,165	3,138,125	3,005,345
TOTAL	32,701,962	30,154,137	44,036,299	40,780,405
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	1,698,048	1,898,251	2,693,244	2,465,402
Paper-treating and paper-coating resins	1,570,786	1,904,929	2,373,474	2,191,959
Bonding and adhesive resins for—				
Laminating	1,978,542	2,071,504	3,060,598	2,987,906
Plywood	5,932,711	6,151,789	8,388,738	7,894,341
All other bonding and adhesive uses	1,933,315	1,763,547	2,312,254	2,670,621
Protective-coating resins, straight and modified	2,758,699	1,847,047	2,912,800	2,282,576
Resins for all other uses, including molding	5,012,517	6,709,994	8,889,606	9,247,126
TOTAL	20,911,618	22,347,061	30,630,714	29,739,931
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	23,168,439	15,445,781	23,320,084	19,649,534
All other	29,712,591	20,916,746	31,716,658	24,785,695
Protective-coatings	4,932,454	4,295,751	5,595,190	5,048,532
Textile and paper treating and coating resins	4,978,772	3,910,587	6,459,940	4,822,567
All other uses	14,448,367	19,250,307	14,713,957	21,213,786
TOTAL	77,240,623	63,819,172	81,805,829	75,531,114
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		5,860,613		9,005,276
Sheeting (resin content)		9,804,638		9,971,251
Molding and extrusion (resin content)		18,414,102		26,087,212
Flooring (resin content)		3,965,982		7,021,083
Protective coating (resin content)		10,106,743		13,739,116
All other uses (resin content)		3,531,193		3,874,121
All other vinyl resins for—				
Adhesives (resin content)		9,155,188		12,383,030
Protective coatings (resin content)		4,133,987		5,539,225
All other uses (resin content)		2,467,843		2,536,038
		9,466,004		9,570,021
TOTAL	83,925,698	76,906,293	94,675,340	99,726,373
Coumarone-Indene and Petroleum Polymer Resins	17,239,089	17,076,865	21,216,721	21,597,444
Polyester Resins:				
For reinforced plastics	8,371,704	8,296,148	9,963,301	8,638,592
For all other uses	1,492,895	1,428,668	1,585,251	1,624,483
TOTAL	9,864,599	9,724,816	11,548,852	10,263,075
Polyethylene Resins:				
For film and sheeting		31,433,272		32,165,275
Molding materials		11,200,235		16,165,343
Extrusion materials		10,118,866		15,917,674
For all other uses		41,748,858		40,241,545
TOTAL	103,695,304	94,501,231	106,950,027[1]	104,489,837[2]
Epoxy Resins:				
For protective coatings		1,617,471		1,793,966
For all other uses		2,589,124		3,147,110
TOTAL	4,886,539	4,206,595	4,886,130	4,941,076
Silicone Resins	440,505	384,728	297,364	374,775
Miscellaneous Synthetic Plastics and Resin Materials	21,221,475	19,641,017	24,911,510	21,592,180
GRAND TOTALS	382,763,270	348,184,111	432,720,091	420,818,971

[1] 17.3% produced by the low-pressure process.
[2] 14.0% produced by the low pressure process.
SOURCE: United States Tariff Commission, Chemical Division.

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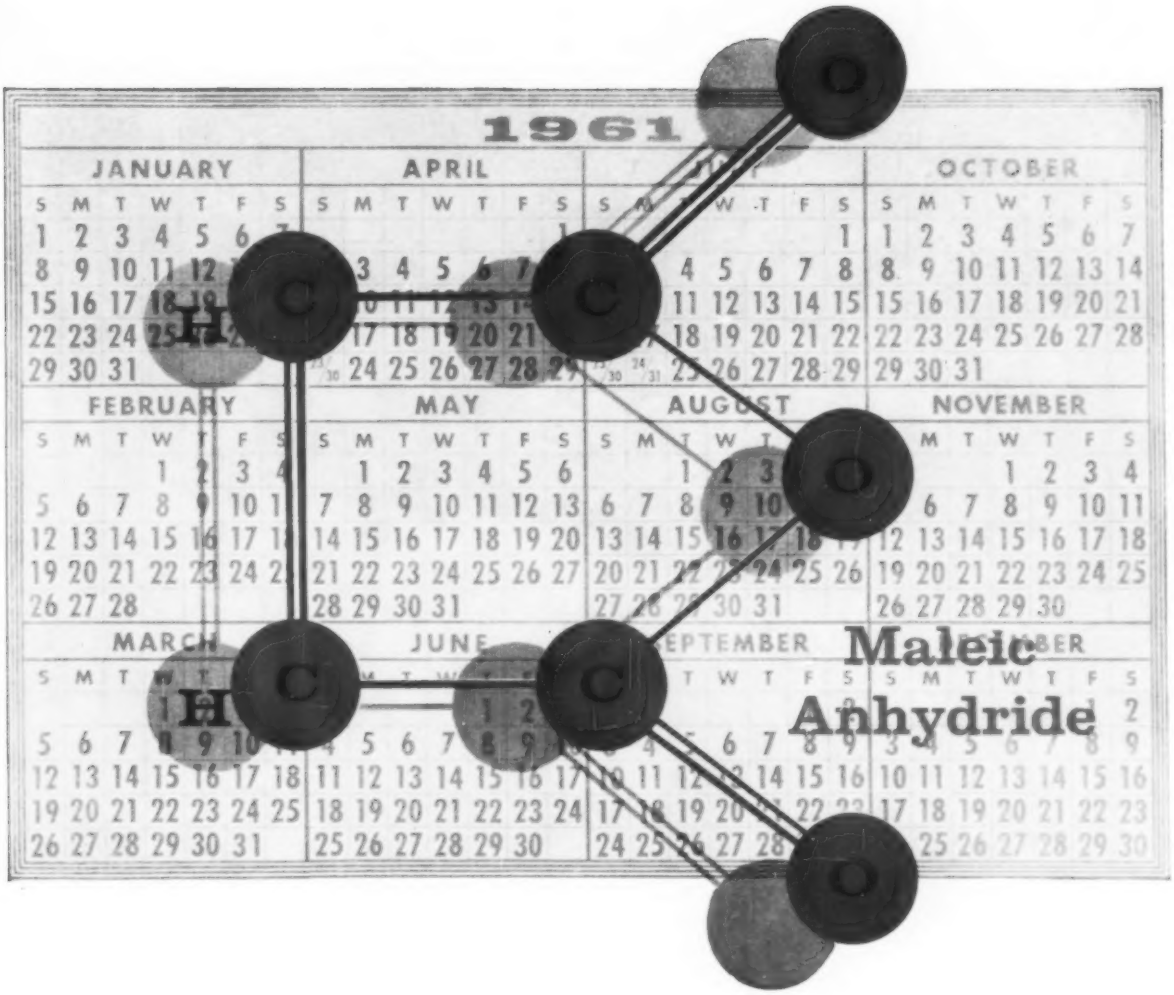

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